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Hay Harvesting Methods And Costs

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PREFACE

This publication contains information on 15 methods of harvesting hay. Some of these are very simple ways of putting up hay and require little equipment, but they are rather expensive in labor input. Others require large investments in haying machinery but, generally, use less labor per ton of hay.

Investment in machinery, annual cost of using the machinery, labor crews and their costs, and total costs per acre and per ton of hay, are here discussed for each method. Generally, these data are summarized and discussed in the main body of the circular, and details for some items, especially for costs of using various pieces of machinery, are shown in the Appendix. Procedures used in computing costs are also discussed in the Appendix.

Many farmers and State and Federal workers contributed in several ways to the haymaking study on which this circular is based. The authors are indebted to all of them.

The photographs are intended only to illustrate various methods of harvesting hay. Some of the methods and some of the machines here illustrated have features which may subject the operator to extreme hazards. Caution in the use of machinery is the best policy, for economy and safety.

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Hay Harvesting Methods And Cost

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Hay is grown on more than half the farms in this country. It is grown on large farms and on small. Every kind of method is used in its harvesting, from the very old-fashioned to the most modern use of mechanization. But mechanization in the hay fields has lagged behind the progress in other phases of farming. It is difficult to develop machinery and mechanized methods that are economically practical for many farmers to buy and to use on hay which is a crop of relatively low cash value per acre.

SCOPE OF STUDY

The study here reported is based chiefly on field surveys conducted during the 1945 haying season on 1,632 farms, located in 17 selected areas in 13 States. The studies were conducted in cooperation with State agricultural experiment stations. In each area, trained enumerators visited 30 or more hay-producing farmers and obtained from them detailed information concerning the time required, and the equipment and labor crews used, in harvesting hay by different methods.

The results of the studies in most of the areas have been published in reports from State experiment stations. Most of these reports were issued in processed form. Although a standard schedule was used in the field work in most areas, the resulting data and tabulations for the various areas were not exactly comparable in all respects. Necessary adjustments to assure comparability were made in the preparation of this summary report. This means that the data presented herein do not always agree exactly with the data in the State publications.

In order to bring some of the data more nearly up to date, some cost and investment data are shown for 1947, as well as for 1945—the year of the study.

Approved sampling procedures were used in selecting the farms for study, so that the results are generally representative of average conditions for the many haymaking methods found on farms that grow small, medium, and large quantities of hay. In some instances, particularly where new machines and methods were just coming into use, the number of cases found was so small that the results may be merely indicative of average conditions. The sampling procedure does not permit the making of estimates of regional and State totals, primarily because of lack of information on the exact importance of each haymaking practice in the region or State.

Since the primary data were collected in 1945 some of the newer methods of making hay have continued to replace the older methods. These changes have altered the regional and State importance of the different hay-harvesting methods, but have not seriously affected the performance rates shown for the specific hay-making methods.

Another phase of the over-all haymaking study, sponsored by the Bureau of Agricultural Economics in 1945, concerned estimates of the relative use of machinery and animal power for cutting, raking, and hauling hay, the form in which hay was sold or stored at haying time, method of storing hay, proportion of hay sold at haying time, and the extent to which machine and hand methods are used in loading and unloading hay. The estimates were developed by the use of a mailed questionnaire to crop correspondents throughout the country. In most States additional information was obtained on the extent of use of hay crops for grass silage, and quantities of hay cured by barn-curing methods, and quantities stored as chopped hay. The results of this phase of the study were published by the Bureau in 1946[1]

OBJECTIVES

The primary purpose of this study of hay harvesting was to learn the methods—both old and new—used by farmers in handling hay and the relation between the principal methods of haymaking and investment in equipment, time and labor required, and cost of harvesting. Differences in haymaking methods arise fundamentally from variations in procedure in handling hay from windrow to storage. Mowing and raking are basic operations for all except a few dehydrating and ensiling methods.

Farmers and manufacturers of farm machinery have been working for years to develop machinery and practices that will harvest the hay crops more quickly and easily. Much progress has been made, but haying is still a heavy and arduous job for most producers.

The tractor mower will cut more hay in a day than two men and four horses will cut with horse-drawn mowers. Tractor buckrakes, hydraulic buckstackers (combination stackers), automatic-tie pickup balers, pickup choppers, and facilities for dehydrating hay crops—all these help in mechanizing the hay harvest. But a great percentage of the farmers with small acreages of hay cannot afford these expensive machines. Some small farmers do use expensive equipment on a custom basis, but many rely on the older types of equipment and practices.

Hay is grown on about 6 of every 10 farms in the United States, and it is grown on more than 20 percent of the harvested crop acreage. Conservation programs and the increasingly popular ideas for grassland agriculture may call for an even greater acreage in hay crops.

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[1] Brodell, A. P., Engebretson, T. O., and Carpenter, Charles G. harvesting the hay crop. U.S. Bur. Agr. Econ. F.M. 57, 22 pp., illus. 1946. [Processed.]

Practically all of the widely used methods of putting up hay can be classified in five or six basic groups, but within each group there are wide variations. These basic groups are: (1) Storing long loose hay in barns; (2) storing long loose hay in stacks; (3) baling hay with pickup and stationary balers; (4) chopping hay for storage, principally in barns; (5) ensiling hay crops; and (6) within these groups are several distinct variations, some of which, for the purpose of this study, are different methods of harvest, whereas others are merely variations within methods.

Each general method has some definite place in haymaking, depending on such things as climate, kind and quantity of hay, use to be made of the hay, and labor and capital available for the enterprise. For example, with a loader and power fork, it may take a farmer who has only 20 or 30 tons of hay as much as 4 or 5 hours per ton to harvest it, but he cannot well afford to invest in an automatic-tie pickup baler that will harvest the hay with only 2 hours of labor per ton, unless he can do custom work for others with it. In the first case his investment in haying equipment is around $435 and in the second case, about $2,200. This circular develops these and other pertinent facts for 15 methods and submethods of putting up hay at harvest time. These discussions point the way to worth-while improvements that can be made in hay-harvesting methods now being used on many farms.

AREAS AND FARMS STUDIED

The 17 areas selected for study are in 13 widely separated States, ranging from Washington and California to South Carolina. These areas were chosen to represent a great variety of hay-growing conditions, kinds of hay, and hay-harvesting methods.

More areas and more farms were selected from the North Central and Northeastern States than were selected from other regions because hay production is relatively more important where dairying is an important industry. Areas in Minnesota, Wisconsin, Pennsylvania, and New York were chosen to represent the North Central and Northeastern regions. The South was represented by areas in Virginia, Tennessee, South Carolina, and Arkansas. The Western part of the United States was represented by areas from Nebraska, North Dakota, Utah, Washington, and California (fig. 1).

Climate of the sample areas in New York and Pennsylvania is such that the harvest is difficult. At haying time these areas get only 60 to 70 percent of possible sunshine, they endure an average of 60 to 70 percent relative humidity in the middle of the day, and they have a 24-hour average temperature of only about 70 degrees (table 1). Combination of these vital weather factors makes for rather poor weather for the hay harvest.

In Wisconsin and Minnesota weather conditions are better. At haying time there is from 60 to 80 percent possible sunshine, the relative humidity at noon during July averages about 50 to

TABLE 1.—*Location, type of farming, and specified climatic features of selected areas*

State	Area of State	County	Type of farming[1]	Climatic features		
				Percentage of possible sunshine, summer June-August[2]	Average relative humidity, local noon, July[3]	Average July temperature[4]
				Percent	*Percent*	*°F*
New York	Eastern	Washington	Specialized dairy	60–70	50–60	69
	Central	Cortland	do	60–70	60–70	70
	Western	Genesee, Livingston, Ontario Wyoming	Dairy and cash crops	60–70	60–70	70
Pennsylvania	South central	Cumberland, Franklin, York	Dairy and general farming	60–70	50–60	75
	Northwestern	Crawford, Erie, Mercer	do	60–70	55–65	71
Wisconsin	Southeastern	Columbia, Dane, Dodge, Jefferson, Rock, Walworth, Washington, Waukesha	Specialized dairy	60–70	55–60	72
Minnesota	Southeastern	Dodge, Freeborn, Goodhue, Rice, Steele, Waseca	Dairy and livestock	70–80	50–55	72
North Dakota	Mouse River Valley	McHenry	Wheat and range livestock	60–70	45–50	69
Nebraska	Southeastern	Richardson	Feed grains and livestock	70–80	45–50	78
Virginia	Upper Piedmont	Culpeper	Dairy and general farming	60–70	50–55	75
Tennessee	Central Basin	Rutherford	General farming, livestock, and tobacco.	60–70	50–55	78
South Carolina	Lower Piedmont	Chester	Specialized cotton	60–70	55–60	80
Arkansas	Mississippi Delta	Mississippi	do	70–80	55–60	81
Utah	Northwestern	Box Elder, Cache	General farming, livestock and special crops.	70–80	25–30	74
Washington	Central irrigated	Kittitas, Yakima	Fruit, truck, and mixed farming.	80–90	25–30	67
	North coast	Skagit, Whatcom	Dairy, poultry, and mixed farming.	60–70	60–70	63
California	San Joaquin Valley	Madera	Mixed farming	Over 90	20–30	78

[1] Adapted from United States Bureau of Agricultural Economics, GENERALIZED TYPES OF FARMING IN THE UNITED STATES. Agr. Inf. Bul. 3, 35 pp; illus. February 1950.

[2] United States Department of Agriculture. YEARBOOK OF AGRICULTURE (CLIMATE AND MAN) 1941: 741.

[3] See footnote 2, p. 734.

[4] See footnote 2, pp. 749–1228. Simple average of all reports given for counties concerned.

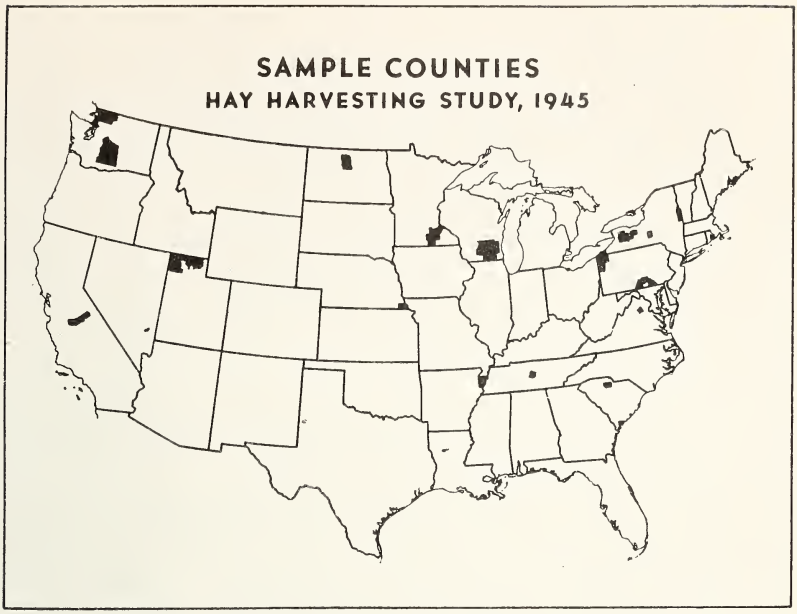

FIGURE 1.—Areas in which the farms included in the hay study are located.

60 percent, and the 24-hour average temperature is 72° during July.

In general, the farther west the area the better the weather for haymaking, because there is more sunshine, the humidity is lower, and the temperatures are higher. Madera County, Calif., for example, receives more than 90 percent of possible sunshine during the months of June through August, the average relative humidity for July noons is only 20 to 30 percent, and the average 24-hour temperature during July is close to 80°.

Areas in the South and Southeast tend to have about the same relative humidity as the New York and Pennsylvania areas and slightly more possible sunshine, but temperatures are 5° to 10° higher.

A notable exception to the usual East—West pattern of haymaking weather is found in the coastal area of the Pacific Northwest, represented by Skagit and Whatcom Counties in northwestern Washington. This area has a relatively low percentage of possible sunshine during the summer and has a high humidity, and an average 24-hour temperature in July of only 63° F. This combination probably makes hay curing more difficult than in any of the other areas included in this study.

The farms studied use both typical and unusual haymaking methods, and include a variety of farm sizes and types. In order to give a basis for evaluating the haymaking information obtained for the sample farms, general data were obtained on size of farm, livestock inventory, crops grown, kinds of hay produced,

TABLE 2.—*Size of sample farms as defined by tons of hay harvested, 1945*

State and area[1]	Small hay enterprise				Medium hay enterprise				Large hay enterprise			
		Average per farm				Average per farm				Average per farm		
	Size of enterprise	Hay harvested	Fields in hay	Size of hay fields	Size of enterprise	Hay harvested	Fields in hay	Size of hay fields	Size of enterprise	Hay harvested	Fields in hay	Size of hay fields
	Tons	*Tons*	*Number*	*Acres*	*Tons*	*Tons*	*Number*	*Acres*	*Tons*	*Tons*	*Number*	*Acres*
New York:												
Eastern	Less than 70	52	4.2	8	70–119.9	97	6.3	9	120 and over	209	7.4	13
Central	....do	48	4.1	7	70–119.9	96	5.2	9	....do	193	7.0	11
Western	....do	46	3.3	8	70–119.9	96	4.8	10	....do	187	6.0	14
Pennsylvania:												
South central	Less than 50	33	2.3	10	50–99.9	75	3.5	12	100 and over	166	4.6	16
Northwestern	....do	33	3.3	7	50–99.9	70	4.2	8	....do	190	4.4	19
Wisconsin	Less than 40	33	2.9	5	40–59.9	48	3.4	6	60 and over	109	3.2	13
Minnesota	....do	28	2.1	7	40–59.9	49	2.6	9	....do	102	2.9	14
North Dakota	Less than 200	126	1.0	166	200–499.9	377	1.0	390	500 and over	1,391	1.0	1,037
Nebraska	Less than 65	48	1.6	11	65–129.9	98	2.6	14	130 and over	160	3.6	16
Virginia	Less than 50	29	2.6	9	50–129.9	72	4.0	12	....do	210	6.0	19
Tennessee	Less than 37	22	2.5	8	37–94.9	63	3.6	12	95 and over	233	5.4	22
South Carolina	Less than 5	3	1.2	3	5–14.9	10	1.5	8	15 and over	44	2.4	20
Arkansas	Less than 20	16	1.4	4	20–59.9	39	2.1	10	60 and over	221	2.6	35
Utah	Less than 100	8	2.3	12	100–199.9	153	3.0	18	200 and over	322	4.0	31
Washington:												
Central irrigated	Less than 90	55	1.9	15	90–179.9	128	2.4	19	180 and over	343	2.5	43
North coast	Less than 50	33	2.0	8	50–99.9	65	2.8	10	100 and over	173	3.6	20
California	Less than 250	158	2.4	11	250–699.9	447	2.9	25	700 and over	2,266	2.9	124

[1] In all tables which carry this column head, within-State areas are designated only for those States in which more than one area was sampled. Table 1 localizes all sample areas within States and names counties in which sample farms are located. Data presented refer to sample areas and are not to be interpreted as total or average for entire State.

and number and size of hay fields per farm (tables 35 and 36).

Primary classification of farms was made on the basis of size of hay enterprise, in terms of number of tons harvested. The farms were classified as large, medium, and small. These size-of-enterprise denotations vary for each area of study. The total range in variation actually is the difference between size in South Carolina and size in California. In South Carolina a small hay enterprise was one which produced less than 5 tons and a large enterprise was one which produced more than 15 tons; in California a small enterprise was one which produced less than 250 tons and a large enterprise was one which produced more than 700 tons of hay. The size of hay enterprises in all other States is between these two extremes. The number of hay fields per farm, and their average size, varies widely in different areas. On the larger farms, for example, the average number of hay fields per farm ranged from 7.4 in the eastern areas of New York to 1 in in the North Dakota area, and the average size per field ranged from 11 acres in the central New York area to 1,037 acres in North Dakota (table 2).

As could be expected, the number of total acres per farm increased as the size of the hay enterprise increased (table 35). Also, the number of animal units of roughage-consuming livestock per farm increased as the size of the hay enterprise increased. Especially was this true in numbers of cattle other than milk cows, which without exception increased as the size of hay enterprise increased. Numbers of milk cows and of horses and mules followed this pattern closely, but there were notable exceptions (table 36).

Hay is harvested from about 20 percent of the total cropland that is harvested in the United States. The percentage of land in hay on the sample farms was somewhat greater than this, however. The percentage of farm land that was in hay was higher on large farms than on smaller farms—about 22 percent on medium and large farms and 16 percent on small farms. This difference is especially pronounced in the South where livestock numbers and land in hay are low on the smaller farms.

The type of hay grown was related to the size of farm. Small farms had a higher percentage of annual hay crops and crops fitting into short-time rotations than did large farms. In areas where alfalfa is grown, it makes up a larger proportion of total hay acreage on large farms than on the smaller farms.

From a tonnage standpoint, alfalfa was of first importance in 10 of the 14 areas reporting on this item. Clover and timothy mixed was of first importance in one eastern area, lespedeza was first in a southeastern area, wild hay was first in the North Dakota area, and clover and grass was first in the north-coast area of Washington (tables 37 and 38).

PRACTICES IN SEEDING AND CURING HAY

Crop history of hayfields on the sample farms in New York and Pennsylvania shows that usually a crop of either oats or

wheat immediately preceded the hay crop, generally as a nurse crop. In the Minnesota and Wisconsin sample areas hay followed oats on practically all fields. The oat crops generally followed corn and were used as nurse crops. In Nebraska, alfalfa was established on either wheat or oats ground. These small grains followed corn in the rotation, but were not generally used as nurse crops for establishing stands of alfalfa. In the sample area of California, most of the alfalfa was seeded on fields that had been in cotton for the previous 2 years, so nurse crops were not used. In the north-coast area of Washington, hay crops generally followed small grains. A nurse crop, usually oats, was used in almost 80 percent of the cases. In the central irrigated area of Washington, hay followed any one of several crops, with no great concentration on any one. About half of the fields of hay were sown with nurse crops, usually oats.

Although it is generally accepted that the maximum feed value from alfalfa hay is obtained when alfalfa is harvested between the one-tenth bloom and the one-half bloom stages, the stage at which alfalfa is actually cut varies greatly. Among the principal reasons why alfalfa is often cut when more or less than one-tenth to one-half of it is in bloom are the length of the growing season and the number of cuttings that can be expected annually, as well as the conditions of weather and the amount of other work to be done at harvest time.

In areas in which only one or two cuttings are usually made, cutting frequently is delayed beyond the one-half bloom stage in order to get a larger yield of dry matter. This procedure was followed to a considerable extent in the Wisconsin area where only 14 percent of the alfalfa hay was cut at or before the one-quarter bloom stage, and more than 70 percent was cut after the one-half bloom stage (table 39).

In areas in which more than two cuttings of alfalfa are usually made, hay was frequently cut before the one-quarter to one-half bloom stage so as to advance the dates of succeeding cuttings. This was so in California, for instance, where 95 percent of the alfalfa hay was cut at or before the one-quarter bloom stage.

The proportion of alfalfa harvested at specific stages of maturity was about the same for each cutting within a given area, except the last cutting in areas where several cuttings were made annually. In general, the proportion of alfalfa harvested in the early bloom stage was somewhat less in grass mixtures than in full stands of alfalfa. When alfalfa was to be dehydrated for meal by a commercial dehydrator it was usually cut at a very early stage of maturity.

Maximum feed value from clover is obtained when it is cut at about the one-half bloom stage. Most of the clover and mixed clover hay on the surveyed farms was cut at or after this stage. There is a tendency to cut clover at a relatively later stage of maturity than alfalfa. This delay, in most cases, is purposely planned as mature clover cures more quickly than does immature clover, and there is less chance for rain damage when the crop is down. Also, in many clover-growing areas, growers expect only

one crop and are not hurried into getting that crop cut. If a second cutting of clover is to be saved for seed, the first crop normally is harvested earlier than it otherwise would be. When clover is grown in mixture with another hay crop, the predominant type of hay in the mixture determines the time of cutting the crop.

Lespedeza hay of highest quality is obtained when the crop is cut in the early bloom stage. Only about one-third of the lespedeza on the farms in the survey was cut in the one-quarter bloom stage or earlier. This delay in harvesting often is due to the practice of leaving lespedeza until enough viable seeds develop to reseed the land by dropping from the plants.

Time required for curing hay depends primarily on the existing combination of sunshine, temperature, rainfall, humidity, and velocity of wind. These factors result in basic differences in haymaking practices in humid or subhumid areas as compared with the more arid areas. The practice generally followed in humid areas, to avoid rain damage is to cut only a relatively small quantity of hay at one time and to leave it in the swath to cure. In the irrigated and other dry-land areas large quantities may be cut at one time. The hay is raked soon after it is cut and is left in the windrows to cure.

In most areas it was customary to let alfalfa lie in the swath for about 24 hours before it was raked (table 40). This period of elapsed time varied greatly between individual areas, the variation being due primarily to the prevailing climatic conditions which either favored or hindered the curing process. In Wisconsin, where conditions were less favorable for curing than in some other areas, most fields of alfalfa hay were raked about 48 hours after they were cut. The least elapse of time between cutting and raking was reported in the Utah area where a large number of the alfalfa fields were raked the same day they were cut. In Nebraska, Tennessee, the irrigated area in Washington, and in California, many fields of alfalfa were raked the same day they were cut, but the major part of them was raked the next day. In Minnesota, Arkansas, and Virginia, very few fields of alfalfa were raked the same day they were cut. Most raking in those States was done on the day after, with secondary emphasis on the period that centered approximately 48 hours after the hay was cut.

Grass-legume mixtures in Minnesota and in the central irrigated area of Washington usually lay for about 24 hours before being raked, as compared with the usual 48 hours of elapsed time in Wisconsin and in the north-coast area of Washington. Lespedeza hay was cured in the mower swath for about 24 hours in most fields in Tennessee and Arkansas. In South Carolina most lespedeza hay was raked the same day it was cut. More than half of the wild hay in the North Dakota area was raked the day after it was mowed, although substantial quantities were raked shortly after being cut, or were even raked simultaneously with cutting.

The length of time that elapsed after hay was raked and before it was baled, chopped, or stored as long loose hay, depended upon the method of harvesting as well as upon the geographical loca-

tion of the area. Hay can be stored more safely at a higher moisture content when it is in long loose form than it can when it is in bales or in chopped form.

In Wisconsin, Minnesota, Virginia, and Tennessee, loose hay from most of the alfalfa fields was stored within 12 hours after it was raked (table 41). In Nebraska and Arkansas most of the loose alfalfa was stored the next day, approximately 24 hours after it was raked; that in Utah and California was handled 2 days, or approximately 48 hours, after it was raked.

When alfalfa was baled with a pickup baler it remained in the windrow longer than when it was stored loose. Pickup baling on most fields in Nebraska, Tennessee, and Arkansas, was done about 24 hours after the alfalfa was raked, while baling on most of the Utah and California farms was done on the third day, or approximately 72 hours after the raking. There was a tendency to leave alfalfa hay that was chopped even longer than this before it was stored.

Usually the time that grass-legume mixed hays lay in windrows was about the same as with alfalfa. In Wisconsin and Minnesota grass-legume hays were stored loose the day they were raked. In both the central irrigated area and the north-coast area of Washington grass-legume mixed hay was stored loose or was baled the day after it was raked. Lespedeza hay was stored loose the day it was raked on the farms in Virginia, Tennessee, and South Carolina. When it was baled, it remained in the windrow less than 1 day in Tennessee; in South Carolina it was baled the day after it was raked.

In many parts of the country the summer of 1945 was unusually wet. This caused more cut hay to be damaged or spoiled in the field than is usually lost. Wet weather was responsible also for a great deal of low-quality hay because its harvest was delayed. Damage due to wet weather, or the likelihood of damage from rain and wet weather, is greatest early in the haying season and lessens as the season advances.

CUTTING HAY

Cutting is usually the first step in making hay. Farmers have been shifting from horse-drawn mowers to tractor mowers at a rapid rate in recent years. Studies by the Bureau of Agricultural Economics indicate that for the United States as a whole the percentage of hay cut with tractor mowers increased from 15 percent in 1939 to about 42 percent in 1944.[2] This shift to tractor power for mowing has continued.

In the late 1930's sales of tractor mowers became relatively prominent in the sales of all mowers; in the early 1940's the number of tractor mowers sold surpassed the number of horse-drawn mowers sold. After 1942, sales of tractor mowers continued to increase until, in 1946, they amounted to more than twice the sales of horse-drawn machines (table 42).

[2] See footnote 1, p. 2.

In this study, the percentage of farms having tractor mowers was directly related to the size of the hay enterprises. Thirty-one percent of the farms having small hay enterprises had tractor mowers only, 54 percent had horse-drawn mowers only, 4 percent had only horse-type mowers pulled by tractor power, 1 percent had both tractor and horse-drawn mowers, and the remaining 10 percent of the farms had no mowers. Thirty-eight percent of the medium-sized farms had tractor mowers only, 50 percent had horse-drawn mowers only, 3 percent had horse-type mowers pulled by tractors, 5 percent had both tractor and horse-drawn mowers, and 4 percent of the farms had no mowers. Both the small and medium sizes of farms were relatively less mechanized than the large farms. About 65 percent of these large farms had tractor mowers only, 34 percent had horse-drawn mowers only, 1 percent had both tractor and horse-drawn mowers, and less than one-half of 1 percent of the large farms had no mowers.

The percentage of hay cut with tractor mowers was greater in every size group than the percentage of farms having tractor mowers, because the tractor mowers were concentrated on the larger farms within each size group.

Horse-drawn mowers generally were used in conjunction with the less-mechanized methods of haying, whereas tractor mowers usually were used with the more highly mechanized methods. For example, in western New York only 13 percent of the sample farms that employed the loader-wagon method of haying had tractor mowers, whereas 96 percent of the farms that employed the pickup baler method had tractor mowers.

Actual investment in mowers generally was higher on farms having tractor mowers than it was on farms having horse-drawn mowers, but mower investment per acre and per ton of hay cut was normally lower for the farms on which tractor mowers were used.

Use of horse-drawn mowers

Mowing required an average of 1.05 man-hours of work per acre when done with horse-drawn mowers. There was little difference in the time required to mow an acre on the farms that had small and medium-sized hay enterprises, both of which took an average of about 1.1 man-hours per acre. The farms that had large hay enterprises used an average of 0.94 man-hours per acre for mowing, or about 10 percent less than the smaller farms. Size and shape of fields affect rate of mowing to some extent. Hay fields tended to be larger on the large farms (table 2). Also, there was some indication that mowing machines on large farms generally were kept in better working condition than those on smaller farms. Another reason for the smaller amount of labor used to mow an acre on large farms was the relatively large quantity of hay mowed at one time. On the small hay farms only enough hay usually was cut for the crew to rake and store in a day, and sometimes in even less than a day. This takes more average time per acre than when the mower is run continuously for longer periods in mowing larger acreages.

Mowing with horse-drawn mowers on all farms averaged close to 0.8 of a man-hour per ton. About 0.91 of a man-hour was used to mow a ton on the small farms, compared with 0.82 of a man-hour on the medium farms, and 0.61 of a man-hour on the large farms (table 3). Thus approximately 50 percent more labor was used to mow a ton of hay on the small farms than was used on the large farms. This difference is accounted for principally by the higher yields on the large farms (table 43), and to a lesser degree by the differences in acre requirements, previously mentioned.

Most of the horse-drawn mowers are of the 5-foot size, although in some areas 6-foot machines are common. In the South 4½-foot mowers are common (fig. 2). Owners interviewed in

FIGURE 2.—Horse-drawn mowers are used by many farmers who have small acreages of hay to harvest, and who use the lesser mechanized methods of harvesting. One 5-foot mower pulled by a good team will cut about 1 acre of hay in an hour.

1945 had paid an average of about $80 per machine for their horse-drawn mowers. Included in this average are those mowers which were "used" machines when bought by present owners. "Used" machines, which made up about one-fifth of the total number of horse-drawn mowers, cost an average of approximately $38 each when they were bought by their present owners. The average horse-drawn mower bought new in 1945 by operators of the sample farms cost about $125. This compares favorably with data published by the Bureau of Agricultural Economics which

indicate that, in 1945, farmers paid an average of $115 for 5-foot horse-drawn mowers.

TABLE 3.—*Man-hours of labor used to cut hay with horse-drawn mowers, by size of hay enterprise, sample farms, 1945*[1]

State and area[2]	Average amount of man-labor used, by size of hay enterprise							
	Small		Medium		Large		All farms	
	Per acre	Per ton	Per acre	Per ton	Per acre	Per ton	Per acre	Per ton
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
New York:								
Eastern	1.15	0.95	1.20	0.81	1.06	0.48	1.23	0.79
Central	1.35	.86	1.31	.64	1.05	.51	1.21	.62
Western	1.15	.74	1.05	.61	.96	.53	1.06	.63
Pennsylvania:								
South central	.97	.74	1.07	.69	.60	.41	.98	.68
Northwestern	.82	.58	1.11	.54	.88	.34	1.00	.52
Wisconsin	1.08	.54	1.03	.47	.91	.34	.98	.41
Minnesota	1.02	.89	.98	.75	.91	.62	.95	.70
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	.90	.76
Nebraska	.92	.90	.92	.92	.67	.58	.85	.80
Virginia	1.20	1.08	1.10	1.00	.96	1.00	1.00	1.00
Tennessee	1.04	1.04	.97	.94	.72	.62	.90	.84
South Carolina	1.23	1 55	1.01	1.14	1.17	1.15	1.16	1.18
Arkansas	1.10	1.60	1.13	1.70	1.18	1.30	1.13	1.60
Utah	1.06	.68	.95	.61	.87	.35	1.01	.63
Washington:								
Central irrigated	1.26	1.01	1.21	1.02	1.35	.60	1.29	.74
North coast	1.20	.44	1.20	.40	.87	.33	1.14	.41
California	1.00	.90	(3)	(3)	(3)	(3)	1.00	.90
Average all farms	1.10	.91	1.08	.82	.94	.61	1.05	.78

[1] See table 2 for definition of small, medium, and large farms for each area.
[2] See footnote 1, table 2.
[3] Averages not calculated for these particular groups because of the small number of reports.

On the farms studied the average annual machine cost was about $21 per horse-drawn mower. Average costs in individual areas ranged from $11.54 in Wisconsin, where 33 acres (on a once-over basis) were cut per machine, to $36.95 in California, where 113 acres (on a once-over basis) were cut per machine. The differences in annual costs were due largely to the items of repairs and services which amounted to $4.69 per machine in Wisconsin and $22.70 per machine in California. Itemized costs for horse-drawn mowers are shown in table 46.

The average total cost of mowing with horse-drawn mowers ranged from $0.98 per acre in Tennessee to $2.57 per acre in the central irrigated area of Washington, with an average of about $1.60 per acre for all sample farms (table 4). On a per ton basis, the cost of mowing ranged from $0.62 in Wisconsin with a high yield to $1.71 in Arkansas where the yield per cutting was low. For all farms the average cost of mowing with horse-drawn mowers was about $1.10 per ton. About 23 percent of the total

TABLE 4.—*Estimated cost of mowing with horse-drawn and tractor mowers, sample farms, 1945*

State and area[1]	Horse-drawn					Tractor-drawn				
	Per acre			Total cost		Per acre			Total cost	
	Machine cost	Horse work	Man-labor	Per acre	Per ton	Machine cost	Tractor work	Man-labor	Per acre	Per ton
New York:										
Eastern	$0.43	$0.86	$0.68	$1.97	$1.26	$0.30	$0.38	$0.35	$1.03	$0.72
Central	.46	.85	.67	1.98	1.00	.41	.45	.41	1.27	.65
Western	.35	.74	.58	1.67	.99	.34	.35	.32	1.01	.60
Pennsylvania:										
South central	.37	.69	.54	1.60	1.10	.24	.30	.28	.82	.57
Northwestern	.43	.70	.55	1.68	.87	.25	.30	.28	.83	.43
Wisconsin	.35	.57	.54	1.46	.62	.24	.32	.33	.89	.45
Minnesota	.31	.48	.57	1.36	.94	.30	.30	.30	.90	.68
North Dakota	.12	.46	.67	1.25	1.17	.08	.21	.18	.47	.47
Nebraska	.19	.42	.55	1.16	.98	.20	.20	.22	.62	.52
Virginia	.21	.54	.40	1.15	1.15	.17	.21	.24	.62	.67
Tennessee	.28	.43	.27	.98	.91	.22	.13	.25	.60	.71
South Carolina	.44	.63	.29	1.36	1.38	.18	.34	.16	.68	.72
Arkansas	.33	.54	.34	1.21	1.71	.23	.24	.13	.60	.73
Utah	.32	.48	.89	1.69	1.05	.29	.26	.34	.89	.62
Washington:										
Central irrigated	.63	.65	1.29	2.57	1.47	.32	.35	.58	1.25	.75
North coast	.51	.57	1.14	2.22	.80	.36	.76	.46	1.58	.59
California	.32	.44	.85	1.61	1.43	.20	.24	.17	.61	.49
Average	.36	.59	.64	1.59	1.11	.25	.31	.29	.85	.60

[1] See footnote 1, table 2.

acre cost was for the mower, 37 percent was for animal power, and 40 percent was for labor.

For all farms, an average of about 60 acres of hay (on a once-over basis) and 7 acres of weeds in pastures, roadsides, seed crops, and stubble were mowed per horse-drawn machine, in 1945. Something like 50 percent of the horse-drawn mowers were used for work other than for mowing hay.

Use of tractor mowers

The use of a tractor mower reduces the time for mowing with a horse-drawn mower by more than one-half (fig. 3). Tractor

Figure 3.—Tractor mowers are used predominately on the larger farms and on farms that use mechanized methods of harvesting. One tractor mower will cut more than twice as much hay in a day as a horse-drawn mower.

mowers used an average of only 0.48 of a man-hour to cut an acre of hay in 1945 compared with 1.05 hours when done with horse-drawn mowers. Tractor mowers were used to cut about twice as many acres per mower as horse-mowers cut, and, especially on the larger farms, their use resulted in substantial reductions in labor requirements for haymaking.

Most of the tractor mowers had 7-foot cutter bars. The average cost of these mowers when bought new by present owners was approximately $150. The average price paid for new tractor mowers in 1945 was near $170.

The average annual machine cost of using a tractor mower was about $20 in Wisconsin and Minnesota, where the annual use averaged close to 75 acres per mower; it ranged up to $123.51 for the California farms, where annual use averaged close to 635 acres per mower. With the large annual use in California the estimated average life of tractor mowers was only 6 years—less than half the life in most of the other areas. Detailed costs for tractor mowers for each area are shown in table 47.

The per acre cost of mowing with tractor mowers was lowest in North Dakota where it averaged $0.47, and relatively low in Nebraska, Virginia, Tennessee, Arkansas, and California, where it averaged about $0.61. It was highest in the north-coast area of Washington and in south central New York where it averaged about $1.58 and $1.27 per acre, respectively. Farms with tractor mowers had larger than average quantities of hay, and the machine cost per ton for mowing was relatively low. Area averages ranged from $0.43 to $0.75 per ton, with an average of close to $0.60 per ton for all farms. Of this total, about 30 percent was for the mower cost and 70 percent was for power and labor (table 4). The machine cost per ton was only about 54 percent as much on farms with tractor mowers as the cost on farms where horse-drawn mowers were used.

Horse-type mowers pulled by tractors were used on about one-fourth of the farms studied in the northwestern Pennsylvania area, but little use was made of such outfits in the other areas. Horse-type mowers are not designed to operate at high ground speeds, and even when pulled with tractors they cut less hay in a given time per foot of cutter-bar width than a regular tractor mower will cut. A crew of two men is often necessary when mowing with a horse-type mower and tractor, thus increasing the labor per acre for mowing.

RAKING HAY

Most methods of harvesting hay require that the hay be in windrows before it is handled by the next haying operation. Both side-delivery and dump rakes are widely used for raking hay. Each type has its advantages.

Side-delivery rakes form straight and even windrows that are easy to follow with pickup machines—the pickup baler, for example. They make a continuous windrow which leaves the hay in a rope-like condition and enables the pickup attachments to do a clean job. A side-delivery rake, traveling in the same direction as the hay was mowed, rolls it so that the leafy parts are inside the windrow and the stem ends are outside.

As side-delivery rakes often are better adapted for use with tractors and mechanized methods of haymaking, they have been rapidly replacing dump rakes in many parts of the United States. Of the hay rakes sold during the 1930's about 35 percent were side-delivery rakes; from 1940 to 1945 about 55 percent of the sales were side-delivery rakes; and since 1945 about 65 percent were side-delivery rakes (table 42). Part of this increase in the

proportion of side-delivery rakes is undoubtedly a result of the increase in the acreage of legumes for hay, as side-delivery rakes are commonly considered to be more satisfactory than dump rakes for raking such legume hay as alfalfa and clover.

Some of the latest types of tractor-drawn side-delivery rakes are made so that the raking reel operates by power take-off, which makes it possible to travel at higher speed while raking (fig. 4). These rakes usually have a four-bar reel which enables

FIGURE 4.—Raking hay with a tractor-drawn side-delivery rake operated with power take-off.

them to handle the larger volume of hay gathered by them as a result of their greater traveling speed. Performance of rakes of this type was not determined in this study, but it is well in excess of 2.2 acres per hour, the average for all tractor-drawn side-delivery rakes in the study. On the farms studied in 1945 almost all of the side-delivery rakes drawn by tractors were of the light-duty, three-bar type, originally designed to be drawn by horses (fig. 5).

A much higher percentage of the hay rakes on larger farms are side-delivery rakes than on small farms, mainly because a higher percentage of the large farms have tractors and use mechanized harvesting methods with which side-delivery rakes are usually associated. For example, in Mississippi County, Ark., only 5 percent of the hay rakes on the small farms studied were side-delivery, while about 70 percent of these on the large farms studied were side-delivery; on the farms in Madera County, Calif.,

side-delivery rakes made up about 39 and 75 percent of all hay rakes on small and large farms, respectively.

Raking in 1945 took an average of 0.45 man-hour per acre when tractor-drawn side-delivery rakes were used and about 0.58 man-hour per acre when horse-drawn side-delivery rakes were used. Thus, substituting tractor power for animal power in pulling light-type side-delivery rakes reduces the time and labor required to rake an acre of hay by approximately 25 percent. It is probable that, with the new side-delivery rakes designed specifically for use with tractors, raking can be done even more swiftly.

Horse-drawn side-delivery rakes were used the least in 1945 on the South Carolina and Wisconsin farms, where they raked an average of 35 and 36 acres each. They were used the most

FIGURE 5.—Raking with animal-powered side-delivery rake. With this type of implement drawn by either horses or mules an average of 1.7 acres are raked per hour.

on the California hay farms where they raked an average of 330 acres. The average per rake for all farms in the study was 95 acres. These figures include hay and all other acreages raked.

Tractor-drawn side-delivery rakes were used on larger acreages. In Wisconsin and Minnesota they were used the least, or on 39 and 40 acres, respectively, in 1945; but in California the average use of side-delivery rakes was 723 acres. The average use for all tractor-drawn side-delivery rakes was 179 acres per machine.

Farm operators who bought new side-delivery rakes in 1945 paid an average of about $150 per rake. In 1947 they paid an average of about 30 percent more for each one than they paid in 1945. Some of this increase in cost was due to an increase in the proportion of heavy-duty types designed for high-speed tractor operation.

The cost of raking with horse-drawn side-delivery rakes in 1945 ranged from $0.65 per acre in Tennessee to $1.43 in the north-coast area of Washington. The average cost in all areas was $0.91 per acre, of which 25 percent was for the rake and 75 percent was for animal power and labor (table 5). Raking costs with tractor-drawn side-delivery rakes were considerably less, the lowest estimate being $0.46 per acre in Arkansas and the highest $1.19 in the north-coast area of Washington. The survey showed the average cost of raking with tractor-drawn side-delivery rakes in all areas to be $0.76 per acre, of which 29 percent was machine cost (table 5).

In most areas the estimated average life of horse-drawn and tractor-drawn side-delivery rakes was from 15 to 20 years. In the California area the average life of the tractor-drawn rakes was only 6 years. The yearly machine cost of using both types of rakes ranged from about $15 to $25. The highest cost was $104 per year for the tractor-drawn type in the California area, where the acreages of hay are large (table 48).

Dump rakes were used to some extent in each of the areas studied. Their use was largely associated with those methods of harvesting in which loose hay was loaded by hand and those in which hay was gathered from the windrow by buckrakes. The windrows formed by dump rakes are characteristically larger than those formed by side-delivery rakes. This is desirable for either hand loading or buckraking. Dump rakes were reported also on farms on which solid stands of grasses were used for hay, and their most exclusive use was in areas in which wild hay was harvested.

There have been some recent changes in design of dump rakes to adapt them for use behind tractors. Some extra wide rakes, even up to 24 feet wide, have been made for such use. Another adaptation in design has been the hydraulic trip which can be operated from the tractor. These changes are of especial interest to large operators in the wild-hay areas of the West.

By far the most common size of dump rake reported was the 10-foot rake (fig. 6). In North Dakota and in Utah, the 12-foot rake was commonly used for wild hay, and in the South, the 8-foot rake pulled by one horse or mule was not unusual. Operators on the farms studied bought only a few new dump rakes in 1945.

The average time used to rake hay with horse-drawn dump rakes was about one-half hour per acre, or approximately 15 percent less time than with horse-drawn side-delivery rakes. Very few dump rakes were pulled by tractors on the farms studied in 1945. Consequently, reliable figures on labor use cannot be given for such raking. It is probable that the use of dump rakes designed for tractor power will decrease the labor required for raking pro-

TABLE 5.—*Estimated cost of raking with horse-drawn and tractor-drawn side-delivery rakes, sample farms, 1945*

State and area[1]	Horse-drawn					Tractor-drawn				
	Per acre			Total cost		Per acre			Total cost	
	Machine cost	Horse work	Man-labor	Per acre	Per ton	Machine cost	Tractor work	Man-labor	Per acre	Per ton
New York:										
Eastern	$0.27	$0.43	$0.34	$1.04	$0.63	$0.17	$0.30	$0.27	$0.74	$0.48
Central	.27	.42	.33	1.02	.64	.18	.29	.26	.73	.48
Western	.23	.41	.32	.96	.61	.18	.29	.23	.70	.47
Pennsylvania:										
South central	.23	.42	.33	.98	.67	.18	.29	.23	.70	.47
Northwestern	.27	.41	.32	1.00	.51	.23	.26	.24	.73	.38
Wisconsin	.32	.31	.30	.93	.39	.33	.32	.29	.94	.39
Minnesota	.25	.25	.30	.80	.58	.46	.27	.27	1.00	.67
Nebraska	.18	.32	.41	.91	.86	.15	.21	.23	.59	.52
Virginia	.19	.33	.25	.77	.69	.12	.25	.17	.54	.49
Tennessee	.18	.29	.18	.65	.65	.16	.28	.15	.59	.59
South Carolina	.46	.30	.14	.90	.85	.26	.28	.12	.66	.64
Arkansas	.20	.28	.18	.66	.75	.16	.19	.11	.46	.48
Utah	.15	.26	.44	.85	.59	.17	.26	.34	.77	.53
Washington:										
Central irrigated	.17	.30	.59	1.06	.65	.20	.27	.45	.92	.58
North coast	.27	.37	.79	1.43	.50	.36	.31	.52	1.19	.40
California	.11	.26	.49	.86	.77	.14	.27	.38	.79	.71
Average	.23	.33	.35	.91	.63	.22	.27	.27	.76	.51

[1] See footnote 1, table 2.

FIGURE 6.—Raking hay with a 10-foot horse-drawn dump rake. Bunching hay by hand from the windrow is often done when the hay is to be loaded by hand.

portionately as much as the new-design, tractor-drawn side-delivery rakes decrease the labor that is used with the old style, horse-drawn side-delivery rakes.

Dump rakes were used to rake an average of 97 acres each, in 1945. If the farms in the wild-hay areas of North Dakota (305 acres per rake) and Utah (426 acres per rake) were excluded the average use per rake for all other areas would be 59 acres. Dump rakes were used on a relatively large scale in California, where each rake averaged 176 acres of use, and in the central irrigated area of Washington, where the average use was 100 acres per rake.

Raking costs with horse-drawn dump rakes ranged from a low of $0.47 per acre in North Dakota to a high of $1.05 per acre in the south-central area of Pennsylvania. The average for all areas was about $0.68 per acre. About 19 percent of this cost was for the rake, 37 percent was for horse work, and 44 percent was for labor (table 6).

Detailed machine costs for dump rakes are shown for each area reporting, in table 49.

METHODS OF PUTTING UP HAY

The most difficult, costly, and labor-consuming part of hay harvesting is getting the hay from windrow into storage. And, of course, the kind of storage and storage methods used have

TABLE 6.—*Estimated cost of raking with horse-drawn and tractor-drawn dump rakes, sample farms, 1945*

State and area[1]	Horse-drawn					Tractor-drawn				
	Per acre			Total cost		Per acre			Total cost	
	Machine cost	Horse work	Man-labor	Per acre	Per ton	Machine cost[2]	Tractor work[3]	Man-labor	Per acre	Per ton
New York:										
Eastern	$0.17	$0.37	$0.41	$0.95	$0.63	$0.17	$0.35	$0.32	$0.84	$0.49
Central	.28	.30	.26	.84	.45					
Western	.16	.35	.27	.78	.46					
Pennsylvania:										
South central	.36	.39	.30	1.05	.72	.36	.37	.34	1.07	.73
Northwestern	.16	.32	.25	.73	.38	.16	.30	.27	.73	.39
Minnesota	.36	.23	.25	.84	.60					
North Dakota	.02	.18	.27	.47	.47	.02	.29	.34	.65	.65
Nebraska	.09	.22	.29	.60	.53					
Virginia	.12	.19	.22	.53	.50	.12	.24	.18	.54	.52
Tennessee	.10	.22	.17	.49	.46					
South Carolina	.14	.26	.16	.56	.57	.14	.21	.28	.63	.65
Arkansas	.15	.25	.16	.56	.79	.15	.34	.18	.67	.94
Utah	.13	.23	.38	.74	.51					
Washington:										
Central irrigated	.15	.28	.55	.98	.65	.15	.37	.80	1.32	.88
North coast	.17	.28	.56	1.01	.37	.17	.29	.84	1.30	.48
California	.09	.23	.44	.76	.68	.09	.30	.68	1.07	.96
Average	.13	.25	.30	.68	.55	.13	.26	.41	.80	.52

[1] See footnote 1, table 2.

[2] Same as for horse-drawn rakes.

[3] There were no tractor-drawn dump rakes reported in the sample areas in Wisconsin, Minnesota, Nebraska, and Utah.

a direct and important effect on the labor requirements and costs of harvesting. Weather is a prime consideration in determining the method to be used in curing and storing hay. Other main considerations are the quantity of hay to be harvested; the time available for the harvest; the power, equipment, and labor available; the distance to storage; and the use to be made of the hay—that is, whether it is to be fed on the farm or marketed.

In 1944, about 62 percent of the total hay crop was stored in barns at haying time, 32 percent was stored in stacks, and 6 percent was sold from the farm at haying time.[3] More than 90 percent of the crop in New England, New York, Pennsylvania, Michigan, and Wisconsin, was stored in buildings. Storage in buildings in all other States east of the Mississippi River and in the more humid areas of the Pacific Coast States accounted for a very large part of the hay. Storing in stacks was the predominating method in the semiarid areas and irrigated valleys of the West. Relatively large quantities of the hay crops were sold before being stored on the farm in California, Arizona, New Mexico, Oklahoma, and Texas.

The same general relation existed between method of storage and geographic location and climate of the 21 areas included in this report, as shown in table 7. Another fact brought out in table 7 is the relation between the quantity of hay harvested and the proportion of the crop that was stored as long loose hay and the proportion that was baled. As the size of the hay enterprise increased the percentage of the crop that was stored as long loose hay in barns decreased, and the percentage that was baled increased.

In the following discussion of the various methods used in harvesting hay, the term "harvesting" is generally used to refer to the handling of hay from windrow into storage. Other interpretations are noted when necessary.

The discussion pertains definitely to those methods found on the 1,600-odd farms studied in 1945. The analysis for each method relates to equipment used, investment in the equipment, harvest crews, time and labor required, and cost of harvesting. The importance of each method on the farms studied is shown by the quantity of hay harvested by each method. This importance is shown in table 44, and is discussed in the text for each method.

Harvesting costs include machinery, labor, and power costs. Wage rates and other pertinent facts concerning the cost estimates are shown in the appendix, beginning on page 77.

HARVESTING LONG LOOSE HAY STORED IN BARNS

Two general methods are used in getting long loose hay from the windrow into the barn. The most common is to load the hay on wagons or other vehicles, with hay loader or by hand, haul it to the barn, and unload by hand or with power forks or slings. The other is to haul the hay from windrow to barns with buckrakes and draw the hay into the mow with power forks or slings.

[3] See footnote 1, p. 2.

TABLE 7.—*Relation between manner of harvesting and tonnage of hay harvested per farm, sample farms, 1945*

State and area[1]	Hay harvested per farm														
	Quantity			Percentage of total											
				Loose hay stored in						Baled			Chopped		
				Barns			Stacks								
	Small hay enterprise	Medium hay enterprise	Large hay enterprise	Small hay enterprise	Medium hay enterprise	Large hay enterprise	Small hay enterprise	Medium hay enterprise	Large hay enterprise	Small hay enterprise	Medium hay enterprise	Large hay enterprise	Small hay enterprise	Medium hay enterprise	Large hay enterprise
	Tons	*Tons*	*Tons*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
New York:															
Eastern	52	97	209	68	56	35	.....	.....	.....	31	40	63	1	4	2
Central	48	96	193	83	70	52	.....	.....	.....	17	24	48	.....	6	.....
Western	46	96	187	70	52	31	.....	.....	.....	26	40	62	4	8	7
Pennsylvania:															
South central	33	75	166	63	38	26	5	.....	1	31	58	69	1	4	4
Northwestern	33	70	190	67	46	12	.....	.....	.....	25	34	76	8	20	12
Wisconsin	33	48	109	79	71	41	.....	3	.....	8	17	34	13	9	25
Minnesota	28	49	102	79	61	28	10	9	20	4	15	30	7	15	22
North Dakota	126	377	1,391	4	.....	.....	96	100	100	.....	.....	.....	.....	.....	.....
Nebraska	48	98	160	48	41	40	7	12	10	45	46	49	.....	1	1
Virginia	29	72	210	59	63	56	28	23	12	13	14	32	.....	.....	.....
Tennessee	22	63	233	62	52	17	15	11	3	23	37	80	.....	.....	.....
South Carolina	3	10	44	97	91	61	.....	.....	.....	3	9	39	.....	.....	.....
Arkansas[2]	16	39	221	63	13	4	.....	.....	.....	37	43	69	.....	.....	.....
Utah	68	153	322	10	5	2	69	55	39	14	26	57	7	14	2
Washington:															
Central irrigated	55	128	343	.....	.....	.....	96	78	60	4	20	35	.....	2	5
North coast[3]	33	65	173	77	65	30	3	.....	.....	7	16	58	.....	2	1
California	158	447	2,266	3	1	.....	35	3	2	47	68	53	15	28	45

[1] See footnote 1, table 2.

[2] 44 percent of the hay harvested from medium and 27 percent of the hay harvested from large farms was dehydrated for meal.

[3] 13 percent of the hay crop from small farms, 17 percent from the medium-sized farms, and 11 percent from the large farms was ensiled.

Load and unload by hand

Even with the high degree of present-day farm mechanization, many farmers in some areas still handle all or a part of their crop by hand. For the most part, however, hand loading and unloading in barns is done only on farms that have small tonnages of hay, or on larger farms where small quantities are stored in mows that are too small for the use of power forks, the rest of the crop being handled by a more mechanized method. On the farms that reported the handling of any hay by this method, more than 50 percent reported no more than 10 tons so handled.

Hand loading and unloading in mows was especially prevalent in the South Carolina area where 94 percent of the hay harvested on the small farms and 54 percent of that harvested on all the farms studied was handled this way. This method was used extensively in the other Southern areas and to an appreciable extent on small farms in New York and Pennsylvania (table 44).

Few and simple machines are needed to harvest hay by this method. A horse-drawn mower, a horse-drawn dump rake, a rack wagon, and two or three pitchforks are enough. If bought new in 1945 the average cost of these items would have been about $230, and if bought in 1947 would have been about $280. The actual average cost, bought at different times and some of it bought as used equipment, was $158 (table 8).

Although this investment is small, the quantity of hay harvested by the farmers who use the hand load and unload method was also small—usually less than 15 tons per farm. Consequently, the equipment investment per ton harvested was higher than for some of the more expensive methods that were used to harvest large tonnages. In the Southeast, farmers frequently did not own a mower or rake, and their investment cost was reduced accordingly. Machines were sometimes borrowed, or labor or other equipment was exchanged for their use.

TABLE 8.—*Estimated initial investment in equipment for harvesting hay, load- and unload-by-hand method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Horse-drawn mower (5 ft.)	$ 80	$ 93	$115	$137
Dump rake	44	52	61	76
Hayrack[3]	30	25	50	60
Pitchforks (3)	4	4	4	5
Total	158	174	230	278

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] Does not include running gear. The cost data for 1935–39, 1945, and 1947 are estimates based on prices of rough lumber and farm wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

The usual crew for harvesting by the hand load and unload method was made up of either two or three men. Pitching hay is hard work and more than 90 percent of the workers engaged in this method were able-bodied men (fig. 7). The usual crew of

FIGURE 7.—Two sturdy men will load and unload by hand about 4 or 5 tons of hay in a 10-hour day, if the haul is not too far. Three men will handle about 6 tons in a day, and the work may be somewhat less tiring.

three men took an average of 1.5 hours per ton to load, haul, and unload, making a total of 4.5 man-hours per ton. A crew of two usually handled somewhat less hay per hour, as one man can load after two pitchers.

The labor used to handle hay from windrow into storage by this method ranged from about 9 man-hours per ton for some in South Carolina down to less than 4 hours for some in New York, Arkansas, Utah, Washington, and California (table 9). When the hay was shocked by hand the total harvest labor was somewhat greater than it was when hay was pitched onto wagons directly from the windrow. Actually, shocked hay was loaded faster than hay not shocked, but the time and labor saved in loading was not enough to offset that required for shocking. It must be recognized, however, that hay cured in shocks is usually of better quality than similar hay that lies in windrows until cured.

Part of the difference in labor requirements among areas and among farms was due to the size and arrangement of buildings in which hay was stored. For example, on the farms in South Carolina where loading and unloading by hand was done the storage capacity of about half the buildings in which hay was stored was not more than 5 tons. Hay cannot be stored as quickly in mows of that sort as it can in mows that are easily accessible and of large capacity.

TABLE 9.—*Labor used to handle 1 ton of long loose hay from windrow into storage, load- and unload-by-hand method of harvesting, sample farms, 1945*[1]

State and area[2]	Load from windrow and store. Haul with		Shock by hand, load and store. Haul with		Bunch with dump rake, load and store. Haul with	
	Animal power	Mechanical power	Animal power	Mechanical power	Animal power	Mechanical power
	Man-hours	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*
New York:						
Eastern	5.5	.....	.....	.....	.....	.....
Western	4.0	.....	.....	.....	.....	.....
Virginia	4.9	4.7	6.2	.....	4.6	.....
Tennessee	6.4	.....	5.5	.....	.....	.....
South Carolina	.....	[3]7.0–8.9	[4]9.2–9.8	.....	[4]7.6–7.7	.....
Arkansas	4.8	[5]3.6–5.0	8.2	.....	7.1	.....
Utah	.....	.....	2.7	.....	.....	.....
Washington:						
Central irrigated	.....	2.6	.....	.....	.....	.....
North coast	.....	.....	5.4	[5]3.4–6.2	.....	.....
California	.....	.....	4.6	3.5	3.2	3.8

[1] Includes both storing in barn and stacking by hand. Labor requirements for these two processes are approximately equal.
[2] See footnote 1, table 2.
[3] Range in man-hours includes both lespedeza and cowpea hay hauled by both tractor and truck.
[4] Range in man-hours includes both lespedeza and cowpea hay.
[5] Range in man-hours includes hauling with trucks and with tractors.

The average cost of moving hay from windrow to storage was close to $3 per ton on the farms that used the hand load and unload method. Roughly, two-thirds of this cost was for labor, using 4.5 man-hours as the standard labor input. And where horse-drawn mowers and dump rakes were used the total haymaking cost was approximately $4.66 per ton (table 10). The cost of making hay by this method increased relatively more in recent years than the cost of any other method, mainly because of the method's heavy dependence on labor; wage rates have risen relatively higher than other factors of production.

The most important characteristic of this method, economically speaking, is that much of the cost is not a direct cash outlay, but is labor cost that is usually supplied by the farm family. The advantages of the method are the low investment costs and the low cash expenditures. The chief disadvantages are the large amount of labor required per ton, the length of the haying season if the crop is large, and the hard work involved.

LOAD BY HAND AND UNLOAD WITH POWER FORK

This harvesting method differs from the hand load and unload method in only one important respect—the hay is unloaded with power forks (or slings) instead of by hand. It is probable also

TABLE 10.—*Comparison of the outstanding features of specified methods of harvesting hay, sample farms, 1945*

Method of harvesting	Average investment in equipment[1]	Average amount of hay handled per crew hour	Typical size of crew	Average man-labor per ton	Average cost per ton handling from windrow into storage	Average total haymaking cost per ton including mowing and raking
		Tons	*Number*	*Man-hours*		
Stored in barns:						
Load and unload by hand	$ 158	0.7	3	4.5	$3.00	$4.66
Load by hand, unload with power fork	208	.7	3	4.0	2.65	4.31
Load with loader, unload by hand	387	.6	2	3.5	2.45	4.10
Load with loader, unload with power fork	437	1.1	3	2.8	1.80	3.54
Buck rake to barn, store with power fork	373	1.6	3	1.8	2.00	3.15
Stored in stack:						
Load and unload by hand	158	.7	3	4.5	3.00	4.66
Buck rake to mechanical stacker	538	2.0	3	1.5	2.00	3.15
Buckstacker	578	3.0	3	1.0	1.25	2.40
Baled:						
Buck rake to stationary baler	1,016	1.7	6	[2] 3.5	5.57	6.72
Automatic-tie pickup baler	2,253	2.6	1	[3] .5	3.22	4.33
3-man pickup baler	1,466	2.4	3	[4] 1.2	3.71	4.82
Chopped:						
Stationary chopper	809	1.0	2	2.1	2.26	3.37
Pickup chopper	2,342	3.5	4	1.1	2.23	3.34
Ensiled:						
Loader, ensilage cutter[5]	629	[6] 2.6	3	[7] 1.2	[7] 1.51	[7] 1.56
Pickup chopper[5]	2,889	[6] 10.0	4	[7] .4	[7] 1.70	[7] 1.75

[1] Investment in machines and equipment used in 1945 harvesting; averages include purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] Man-hours of labor for baling only. Labor for hauling and storing bales averaged 1.1 man-hours, which brings total labor for handling from windrow into storage up to 4.6 man-hours.

[3] Man-hours of labor for baling only. Labor for hauling and storing bales baled by pickup balers averaged 1.5 man-hours, which brings total labor for handling from windrow into storage to 2.0 man-hours.

[4] Man-hours of labor for baling only. Labor for hauling and storing bales baled by pickup balers averaged 1.5 man-hours, which brings total labor for handling from windrow into storage to 2.7 man-hours.

[5] Data based on special survey of northeastern Pennsylvania farms in 1948.

[6] Tons of silage.

[7] Per ton of silage.

that on some of the larger farms more of the hay is hauled on motortrucks and on tractor-drawn wagons and trailers.

These differences are associated with larger farms which have more power equipment, more hay to harvest, and larger barns and storage mows than small farms.

Most of the farmers reporting this method harvested from 20 to 30 tons of hay in the 1945 season. The method was extensively used on the farms studied in Virginia, Tennessee, and South Carolina, and the north-coast area of Washington (table 44).

Usual equipment for this method consisted of a horse-drawn mower, a horse-drawn dump rake, rack wagon, and unloading equipment installed in barn. The barn equipment includes track, carrier, fork, and ropes. The initial cost of this equipment, installed over a long period, including labor for installation, averaged about $50 per farm. If installed new in 1945 the average cost would have ranged from about $100 to $130, depending on the type of fork or sling. In 1947 the same equipment installed would have cost $134 to $162 (table 11). This investment in mow equipment for unloading sharply increased the cost of equipment for this method over that for the hand load and unload method. In 1947, the increase was from $278 to $422, a rise of approximately 50 percent (table 12).

TABLE 11.—*Estimated initial investment in installation of track and power fork or sling equipment, average 1935-39, annual 1945 and 1947*[1]

Item	Cost if purchased new		
	1935–39	1945	1947
Power forks:			
Harpoon (1)	$ 2.50	$ 3.00	$ 4.00
Grapple (1)	10.00	12.00	14.00
Slings (3)	15.00	28.00	32.00
Main rope ¾ inch (250 ft.)	9.00	17.25	22.00
Trip rope $\frac{5}{16}$ inch (125 ft.)	1.30	2.40	3.00
Track (75 ft. long)	11.25	15.00	24.00
Hanger hooks and brackets	7.30	9.60	15.00
Hay carrier	10.50	13.50	18.00
Single pulley and anchor	1.50	1.90	3.00
Wood members across rafters, nails, and bolts	8.70	14.80	19.00
Labor for installation—50 man-hours of farm labor	6.65	22.40	25.85
Total:			
With harpoon fork	58.70	99.85	133.85
With grapple fork	66.20	108.85	143.85
With slings	71.20	124.85	161.85

[1] The cost data are estimates based on prices of materials used and farm-wage rates, and on the estimated quantities of materials and labor used in the installation.

TABLE 12.—*Estimated initial investment in equipment for harvesting hay, load-by-hand- and unload-with-power-fork method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Horse-drawn mower (5 ft.)	$ 80	$ 93	$115	$137
Dump rake	44	52	61	76
Hayrack[3]	30	25	50	60
Pitchforks (3)	4	4	4	5
Total	158	174	230	278
Track and power fork[4]	50	66	109	144
Total	208	240	339	422

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from *Agricultural Prices*, a monthly publication issued by the Bureau of Agricultural Economics.

[3] Does not include running gear. The cost data for 1935–39, 1945, and 1947, are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

[4] Taken from table 11.

As with the hand load and unload method the usual size of crew was two or three men. But a higher proportion of the workers, especially those driving the team when unloading, were boys or girls. The average labor used in handling hay from windrow into storage was about 4 man-hours per ton, although the average was much less in the more important haymaking areas (table 13). This over-all average was built up from these average or typical components: Shocking, 0.5 man-hour; loading by hand, 1.8 man-hours; hauling to barn and returning to field, 0.7 man-hour; unloading with power fork, 1.0 man-hour; total, 4.0 man-hours. Hauling with mechanical power required somewhat more hours per ton, probably because of the more frequent use of an extra person for driving the load and because of longer average hauls.

Within a specific area the number of man-hours per ton used to load by hand and to unload with power forks or slings was normally about 80 percent as much as that used to load and unload by hand. This is an elimination per ton of more than a half man-hour of strenuous work. Some of this reduction may be attributed to factors other than the mere substitution of power unloading for hand unloading. Differences in the planning and management of the harvest and in the type and arrangement of storage buildings accounted for some of the difference in labor use.

A crew of three men using this method usually stored about 1 ton of hay in 1.35 hours, a total of 4 hours work for the crew. The average cost of harvesting after the hay was in the windrow was about $2.65 per ton. Total harvesting cost, including mowing and raking with horse-drawn equipment, was about $4.31 per ton

(table 10). This cost per ton is relatively high, primarily because of the high man-labor requirement. But the quantity of hay harvested on most farms using this method is not large and would not economically justify the purchase of considerable additional equipment, especially as much of the work is done by the family. The method reduces somewhat the hard work made necessary by the hand-load and unload method, but it still means heavy work.

TABLE 13.—*Labor used to handle 1 ton of long loose hay from windrow into storage, load-by-hand- and unload-with-power-fork method, sample farms, 1945*

State and area[1]	Load from windrow and store. Haul with		Shock by hand, load and store. Haul with		Bunch with dump rake, load and store. Haul with	
	Animal power	Mechanical power	Animal power	Mechanical power	Animal power	Mechanical power
	Man-hours	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*
New York:						
Eastern	3.4–5.3	.....	.....	.....	.....	.....
Western	3.3–4.0	3.8	.....	.....	.....	.....
Tennessee	4.9	.....	5.4	.....	5.6	.....
South Carolina	4.8	5.8–6.1	.....	.....	.....	.....
Arkansas	.....	2.5	.....	.....	5.8	.....
Utah[2]	2.6	2.3–3.0	.....	.....	.....	.....
Washington:						
Central irrigated[2]	[3]1.6–3.3	[3]2.2	[3]2.8–3.8	[3]2.6–4.5	.....	.....
North coast	2.7–2.8	2.8–2.9	3.7–4.5	3.9–5.2	.....	.....
California	.....	.....	4.0	.....	.....	4.2

[1] See footnote 1, table 2.
[2] Unload with derricks.
[3] Hauled on sleds.

LOAD WITH LOADER AND UNLOAD WITH POWER FORK

This old-time standard method is by far the most used method of loading and storing long loose hay in barns, especially in the heavy hay-producing areas in the northeast quarter of the United States. Its use was reported in 13 of the 17 areas included in this study. It was used particularly on farms in the Wisconsin and Minnesota areas, and almost as much in the Nebraska and Pennsylvania areas (table 44). Farmers who used this method harvested a wide range of tonnages from a low of only a few tons to more than 300 tons on one farm. The largest number of users harvested with this method an average of about 50 tons per farm. It was used more extensively on small and medium-sized farms than on large farms, in most areas. A notable exception was found in Virginia where 50 percent of the hay on the large farms was harvested by this method compared with 28 percent on the medium and 17 percent on the small farms.

Much of the hay put up by this method is mowed with horse-drawn mowers and raked with horse-drawn side-delivery rakes. However, tractor mowers and rakes are coming in rapidly in many areas as the older types are replaced. A hayloader, rack wagon and power fork for unloading completes the list of equipment required for this method. The initial investment for this equipment averaged $437 when it was bought by operators of the farms studied. An additional $85 was spent by those who bought tractor mowers instead of horse-drawn mowers (table 14). In 1947, the cost of this equipment had risen to about $750 with horse-drawn mower included, and to $810 with tractor-drawn mower included.

TABLE 14.—*Estimated initial investment in equipment for harvesting hay, load-with-loader- and unload-with-power-fork method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Horse-drawn mower (5 ft.)	$ 80	$ 93	$115	$137
Tractor mower (7 ft.)[3]	165	138	170	192
Side-delivery rake	140	129	151	196
Hay loader	133	133	170	213
Hayrack[4]	30	25	50	60
Pitchforks (3)	4	4	4	5
Track and power fork[5]	50	66	109	144
Total:				
With tractor mower	522	495	654	810
With horse-drawn mower	437	450	599	755

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from farm machinery dealers.

[4] Does not include running gear. The cost data for 1935–39, 1945, and 1947, are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

[5] Taken from table 11.

Three workers composed the usual crew when this method was used, but frequently one member of the crew was a boy or girl who drove the team during the loading and unloading. The average crew was somewhat larger when a truck or tractor was used for hauling, as the driver in such cases had little or no chance to aid the others in placing hay on the load.

The time necessary for loading as indicated in individual reports varied from 12 to 40 minutes; the low range of 20 to 25 minutes was most frequently reported (fig. 8). Unloading also took an average of about 20 to 25 minutes per load of approximate-

FIGURE 8.—Twenty to 25 minutes are usually required to load approximately 1 ton with a hay loader or crew such as shown above. This hay loader eliminates about half of the hand work required when the hay is loaded by hand.

ly 1 ton. Traveling to and from the field took on the average about 10 minutes. The entire job of loading, hauling, and unloading, took an average of close to 55 minutes. When the length of haul is long, hauling with trucks or tractors takes less time than hauling with horses. On the sample farms the effect of faster hauling with tractors and trucks tended to overcompensate for the effect of the slightly larger average crew used, the net result being that the average total man-hours for loading, hauling, and storing a ton of hay was somewhat less when tractors or trucks were used for hauling than when animal power was used (table 15).

The man-hours used per ton varied widely, but most of the area averages fell within the narrow range of 2.5 to 3.0 hours per ton. The average of all reports from all areas was 2.8 man-hours per ton. This average may be broken down into these parts which were commonly reported: Loading, 1.1 man-hours; haul to barn and return to field, 0.7 man-hour; unload with power fork, 1.0 man-hour; total, 2.8 man-hours per ton.

The cost of moving hay from windrows into storage by this method average $1.80 per ton. The total haymaking cost was about $3.54 per ton when horse-drawn mowers and horse-drawn side-delivery rakes were used and about $2.91 when tractor mowers and tractor-drawn side-delivery rakes were used (table 10).

TABLE 15.—*Labor used to handle 1 ton of long loose hay from windrows into storage, load-with-loader- and unload-with-power-fork method, sample farms, 1945*

State and area[1]	Hauled with			Average
	Animal power	Tractor	Truck	
	Man-hours	*Man-hours*	*Man-hours*	*Man-hours*
New York:				
Eastern	2.7	2.7	2.2–2.6	2.6
South central	2.9	2.7	2.5–2.9	2.7
Western	2.5	2.6	2.6–2.7	2.6
Pennsylvania:				
Southern	3.0	3.0	2.3	2.9
Northwestern	2.7	2.2	2.7	2.6
Wisconsin	2.7	2.4–2.5	1.7	2.4
Minnesota	1.8	2.3–2.6	.....	2.2
Nebraska	3.1	2.4–2.6	2.3	2.6
Virginia	4.4	4.2–5.1	5.7	4.7
Tennessee	2.9	3.9	.....	3.7
Arkansas	.....	2.5	.....	2.5
Utah	4.0	1.7–2.0	.....	2.3
Washington: North coast	1.9	3.0–3.3	2.7	2.9
California	.....	2.0	2.0	2.0
All areas	2.9	2.8	2.6	2.8

[1] See footnote 1, table 2.

Advantages of this method most frequently mentioned by farm operators were: (1) The relatively low investment in haymaking equipment and (2) the effective utilization of family labor. A boy or girl often drove team, tractor, or truck in the field and at the barn when power forks were used for unloading. It may be noted also that this method is among the less expensive. The disadvantage most frequently mentioned was the heavy work for the man who placed the hay on the load.

This method is commonly considered to be adaptable to farms that produce up to 100 tons of hay. In general, the farmers who were using it were satisfied with the labor required, but some were definitely interested in finding an economical way of making hay that did not require such hard work.

Some farmers in the Virginia and north coast of Washington areas loaded small quantities of hay with loaders and unloaded it in barns by hand. This practice was followed where the mows were small, or generally not used for hay. The method required a hay loader in addition to the equipment used by the hand load and unload method, but did not require a track and power fork in the barn. In 1947, the average cost of the track, power fork, rope, and pulleys, was about $145, and the average cost of the hay loader was about $215. Based on the average price paid by farmers for hay loaders in 1945 or earlier, the average machine cost of using a hay loader in 1945 ranged from $14 to $20 in most areas. In the California area it was $48.69 per year. For all areas,

depreciation, based on an average life of 20 years, made up 43 percent of the total cost (table 50).

The crew used for handling hay in this way is normally two, and frequently three, able-bodied men, which is nearly the same as the crew for the load and unload by hand method. The work of loading from a hayloader is strenuous, but the job can be done in about 60 to 65 percent of the time it takes to pitch and load by hand. Indications are that just under 3.5 man-hours were required to handle hay from windrow to storage. A break-down of this is as follows: Loading with loader, 1.1 man-hours; hauling to barn and returning to field, 0.7 man-hour; unloading by hand, 1.5 man-hours; total 3.3 man-hours.

FIGURE 9.—Tractor buckrakes are used to transport hay from windrows to barn or to stack. When the physical lay-out of a farm permits buckraking hay to the barn, it is an efficient and quick way of moving loose hay. The average performance of this type of buckrake, operated by 1 man, was 1.6 tons hauled per hour.

Because of the small number of sample farms using this method, the cost of harvesting was not calculated, but it is estimated to lie approximately midway between the total cost of harvesting with the load- and unload-by-hand method ($4.66 per ton) and load-with-loader and unload-with-power-fork method ($3.54 per ton).

BUCKRAKE TO BARN AND STORE WITH POWER FORK

Buckrakes have been used for a long time to transport hay to stacks or to stationary balers, but in most parts of the country

buckrakes have been used to carry hay to barns for storage only fairly recently. This method was used rather infrequently on the sample farms, but when used, between 30 and 40 tons was the most usual quantity of hay handled. The buckrake is usually loaded from the windrow. On most of the mechanically powered buckrakes the teeth can be raised slightly so the load of hay is literally carried to the barn. Then it is dumped in a location from which it can be drawn into the barn by power forks or slings.

Tractor mowers and horse-drawn dump rakes were commonly used to cut and rake the hay for the buckrake, although some use of side-delivery rakes was reported in a few areas. Only mechanically powered buckrakes were used on the sample farms to take

FIGURE 10.—A typical auto buckrake made from parts of an old automobile. In this picture straw is being hauled. Performance of this type of buckrake is practically the same as that for tractor buckrakes. However, an auto buckrake generally represents more of an investment than does a tractor buckrake as the tractor is not considered a part of the outfit.

hay to barns. Many of these were mounted on the chassis of old automobiles or on trucks. They were largely home-made rigs, especially in the New York and Pennsylvania areas. However, tractor buckraking is becoming a more widely used standard practice. In the areas of eastern United States, and in the north-coast area of Washington the average age of buckrakes was only 2 or 3 years, and many farms used them for the first time, in 1945.

The average initial cost of the buckrakes as evaluated by the farmers was about $110. Those that were factory-made cost $125 to $135, whereas most of the home-made ones cost between $90

and $100. But when the auto or truck chassis is added to the cost of the home-made buckrake, the usual value as reported by the farmers was between $150 and $250. Total investment in a standard set of equipment to harvest by this method was $373 as set out in table 16. The average cost of similar equipment in 1947 was about $560, including a 7-foot tractor mower. Thus, the investment in equipment for haying by this method was relatively low, particularly because the buckrake is self-loading and also does the hauling chore (figs. 9 and 10).

TABLE 16.—*Estimated initial investment in equipment for harvesting hay, buckrake-to-barn- and store-with-power-fork method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Tractor mower (7 ft.)[3]	$165	$138	$170	$192
Dump rake	44	52	61	76
Tractor buckrake[4]	110	65	125	145
Pitchforks (3)	4	4	4	5
Track and power fork[5]	50	66	109	144
Total	373	325	469	562

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1935–39, 1945, and 1947, are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[5] Taken from table 11.

The usual size of crew putting up hay by this method was two or three persons. The size of load hauled varied from about 300 pounds to more than 1,000 pounds depending somewhat upon the type of hay, the terrain, and the length of haul. The usual load was about 650 pounds—roughly 3 loads per ton. Under reasonably favorable conditions the average time required per load to travel to the field, load, and return to barn was about 12 minutes. With this method there is no necessity for the buckrake to wait at the barn as it can be drawn from under its load and returned to the field at once. Even so, the usual facilities for storing hay are not hard put to store a buckrake load in the 12 minutes before the buckrake returns with another load. Average performance was 1.6 tons stored per hour with a 3-man crew.

Man-hours used to handle hay from windrow into storage by this method ranged from less than 1 hour per ton to as high as 4, but most of the farmers reported between 1.6 and 2.0 hours.

The calculated average was 1.8 man-hours per ton (table 17). These man-labor requirements per ton were lower than for any other method reported for storing long loose hay in barns.

The average cost of moving hay from windrow into barn with a buckrake was about $2.00 per ton. The addition of $1.15 for cutting with tractor mower and raking with horse-drawn dump rake brought the total average haymaking cost to about $3.15 per ton (table 10).

TABLE 17.—*Labor used to handle 1 ton of long loose hay from windrow into storage, buckrake-to-barn- and store-with-power-fork method, sample farms, 1945*

State and area[1]	Hauled with			Average
	Animal power	Tractor	Truck	
	Man-hours	*Man-hours*	*Man-hours*	*Man-hours*
New York:				
Eastern		1.8	1.4–2.2	1.8
South central		1.1–1.4	1.5–2.9	1.8
Western		1.6–2.0	1.7–2.6	2.0
Pennsylvania:				
South central		1.7–2.3	1.5–2.7	2.0
Northwestern		1.7–2.0	2.2–2.3	2.0
Wisconsin		1.8	1.6	1.7
Washington: North coast	1.3	1.5–1.8		1.6
All areas				1.8

[1] See footnote 1, table 2.

The machine cost of using horse and tractor buckrakes averaged about $24 in 1945. The average buckrake cost per ton was 10 cents for all farms, 31 cents for the eastern areas where the hay was put in barns, and 8 cents in the areas of Minnesota, North Dakota, and Utah, and in the central irrigated area of Washington. These costs do not include the horse or tractor costs (table 51). The machine cost for auto buckrakes, including the cost of motor fuel, averaged $68.34 per year in 1945, and 65 cents per ton of hay (table 52).

If buckrakes are to be used efficiently in transporting hay, the fields must be relatively smooth in terrain and surface, and the lane of approach to the barn must be smooth and have no abrupt turns. If these conditions prevail and the fields are relatively close to the barn, man-labor can be used very efficiently. This investment is not much different from that required when hay loaders are used. Also, in the buckrake-to-barn method much of the heavy labor is avoided and a greater proportion of workers who are not able-bodied can be used efficiently than is the case with most other methods. Many farmers who formerly used hay loaders or other equipment to handle loose hay have adopted the buckrake system to advantage. This method, especially on the more level farms of the Northeast, is being adopted on the small

and medium-sized farms largely to replace the load-by-hand methods and for replacing the load-with-loader method on the smaller "hay loader" farms. In contrast, pickup baling is being adopted in this region on the larger "hay loader" farms.

HARVESTING LONG LOOSE HAY STORED IN STACKS

Some hay is stacked outside in all parts of the United States, but most of the stacking is done in the dry western areas. In these areas stacking is a general practice, followed year after year. In the humid areas the amount of stacking often may vary with the size of the crop. The general practice is to store the hay in barns, except in years of a surplus, but a general exception is found on some farms that have no inside storage space, and on those with hay fields far removed from barns or so located that it seems desirable to stack and feed the hay in the open, where cut.

Almost 100 percent of the hay was stacked on the North Dakota farms and large quantities were stacked on the farms included in the Utah area and the central irrigated area of Washington. The smaller hay producers in the Virginia, Tennessee, and California areas stacked large quantities in 1945 (table 7).

Load and unload by hand

In the eastern and southeastern parts of the country the hay that is stacked is commonly loaded by hand onto rack wagons, hauled to the stack site, and pitched onto the stack by hand. In nearly 75 percent of the cases that reported this method not more than 20 tons of hay were so handled.

The haying equipment, when this method was followed, usually consisted of a horse-drawn mower and dump rake, a hayrack and pitchforks—the same equipment that is used when the hay is loaded and unloaded by hand in barns. The 1947 average value of these items was about $280 (table 8).

The usual crew is three men; working steadily they will load, haul, and stack a ton of hay, in about 1.5 hours time, a total of 4.5 hours of labor per ton. The haul is frequently shorter when the hay is stacked than when it is stored in barns, but compensating for this in the humid areas is the longer time for unloading because of the special care necessary in placing the hay to prevent excessive damage by weather.

The cost of harvesting by this method is estimated to be the same as for loading and unloading by hand in barns, or $3 per ton from windrow into stack, and $4.66 per ton including mowing and raking (table 10).

Buckrake to stacker

The buckrake-to-stacker method of harvesting is extensively used in the Western States, especially where large acreages of wild hay are harvested. But it is not used exclusively for wild

hay, for especially in irrigated sections, alfalfa and other tame hays are so harvested. As a rule, overshot and side stackers are used for stacking wild hay, while derrick stackers, Jackson forks, etc., are used more for stacking alfalfa.

Basic equipment commonly reported for stacking by this method consisted of a tractor mower, horse-drawn dump rake, tractor buckrake, overshot stacker, and in many cases a stacking frame for one side of the stack. Total investment in this equipment was $538, as itemized in table 18. In 1947, the same equipment would cost about $700, if purchased new.

In the areas in which this method is frequently used, farm mechanization in general, as well as mechanization of the hay harvest, has progressed to a high degree. One tractor mower has replaced two or three horse-drawn mowers in the amount of work done. One tractor buckrake has replaced two horse-drawn buckrakes and, in many cases, trucks or tractors have replaced teams on the overshot stackers. Mechanization of raking—a light-draft operation—has not been so rapid as mechanization of the operations of heavier draft. This is particularly so in the wild-hay areas where the dump rake is preferred. Little mowing is now done with horses in areas where this method is used, but a substantial amount of raking and buckraking is still done with horses.

TABLE 18.—*Estimated initial investment in equipment for harvesting hay, buckrake-to-stacker method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Tractor mower (7 ft.)[3]	$165	$138	$170	$192
Dump rake	44	52	61	76
Tractor buckrake[4]	110	65	125	145
Overshot stacker[4]	190	115	220	240
Pitchforks (3)	4	4	4	5
Stacking frame[5]	25	16	33	38
Total	538	390	613	696

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of the earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1935–39, 1945, 1947, are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[5] Largely home-made. The cost data for 1935–39, 1945 and 1947, are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the stacking frames.

The size of the crews harvesting by the buckrake-to-stacker method varied greatly, and was directly related to the size of the hay enterprise—that is, the larger the hay enterprise the larger the crew. Exchange work accounted for a considerable proportion of the work on the smaller hay farms and the hired work became relatively more important as size of the hay enterprise increased. The minimum size of crew was three persons—one on the buckrake, one to operate the stacker, and one man on the stack. A crew of this size handled up to 2 tons per hour. Frequently, two men were on the stack even with only one buckrake hauling. An addition of one man to the minimum crew of three enables the crew to handle 2 tons of hay per hour with comparative ease (fig. 11).

FIGURE 11.—The overshot stacker is used in many Western areas where hay is stacked outside. A crew of five, as pictured above, can stack 3 to 4 tons of hay per hour. On many farms one tractor buckrake has replaced two horse-drawn buckrakes.

Crews of five were commonly used—two on the buckrakes, one to operate the stacker, and two men on the stack. A crew of this size normally stacked 3.5 to 4 tons per hour. The maximum quantity one overshot stacker can handle appears to be around 5 tons per hour, regardless of how much faster the hay is supplied. This rate of stacking means about 15 stacker-loads per hour, or 1 load every 4 minutes. Often in the dry areas very little placement of hay is done by the men on the stack. The hay usually was put on the stack as rapidly as the stacker could handle it easily, the stacking crew doing whatever essential placement they could manage in the interval between stacker loads.

On the average, it took about 1.5 hours of man labor to haul and stack a ton of hay with a three-man crew, and about 1.3 hours per ton with a five-man crew.

The estimated cost of handling hay from windrow into stack by the buckrake-to-stacker method was $2 per ton for the three-man crew stacking at the rate of 2 tons per hour, and $1.75 per ton for the five-man crew stacking at the rate of 4 tons per hour. Average mowing costs with tractor mowers ($0.60 per ton) and raking costs with horse-drawn dump rakes ($0.55 per ton) bring the total haymaking cost up to $3.15 and $2.90 per ton for three-man and five-man stacking crews, respectively (table 10).

Overshot stackers in North Dakota handled 580 tons of wild hay per stacker in 1945, at a machine cost for the stacker of 3 cents per ton. In Utah, derrick stackers handled an average of 150 tons each at a cost of 14 cents per ton for the stacker and 4 cents per ton for the slings and cables (table 53).

Buckstacker

Power buckstackers (combination stackers) to a considerable extent are replacing other methods of stacking in some areas of the West. A buckstacker is a tractor-attached implement (a combination buckrake and stacker) that gathers hay from the windrow and places it on the stack. Buckstackers are often called combination stackers and sometimes called sweepstackers and are of two general types, mechanical lift and hydraulic lift, the latter being a more recent development.

TABLE 19.—*Estimated initial investment in equipment for harvesting hay, buckstacker method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Tractor mower (7 ft.)[3]	$165	$138	$170	$192
Dump rake	44	52	61	76
Pitchforks (3)	4	4	4	5
Buckstacker[4]	365	300	400	450
Total	578	494	635	723

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1935–39, 1945, and 1947, are estimates based on data obtained in the survey and in special reports from dealers in farm machinery.

As the buckstacker does the work of buckrake, overshot stacker, and stacker frame, it replaces these three items in the list of equipment necessary to harvest by the buckrake-to-stacker method. Operators who used buckstackers reported that they paid an average of $365 for them. Other necessary items of equipment are a tractor mower, a dump rake, and the universally required pitchforks. These items add $213 to the buckstacker investment as reported by the users of this method and bring the total investment in hay equipment to $578. In 1947, this equipment would cost an average of about $723 if bought new (table 19).

FIGURE 12.—A 3-man crew with the type of hydraulic buckstacker shown above will stack an average of about 3 tons per hour. (U.S.D.A. Extension Service photo.)

By using a buckstacker instead of an overshot stacker, it is possible to make considerable reduction in size of crew. With the buckstacker a three-man crew—one man operating the buckstacker and two men on the stack—usually stacked about 3 tons of hay per hour. This size of crew was the most frequently reported in the study; but it was not unusual, especially where the hay enterprise was very large and part of the hay was far from the stack site, for one or two buckrakes to be used in conjunction with the buckstacker. When this was done the buckstacker worked on the hay near the stack while the buckrakes brought loads in from farther away and deposited them for the buck-

stacker to pick up and place on the stack. A crew of four men with one buckrake and a buckstacker stacked as much as 5½ tons of hay per hour, about 4½ tons per hour being an average rate of performance.

The three-man crews stacking at the rate of 3 tons per hour used an average of 1.0 man-hour per ton, while the four-man crews stacking at the rate of 4½ tons per hour used an average of about 0.9 man-hour per ton (figs. 12 and 13).

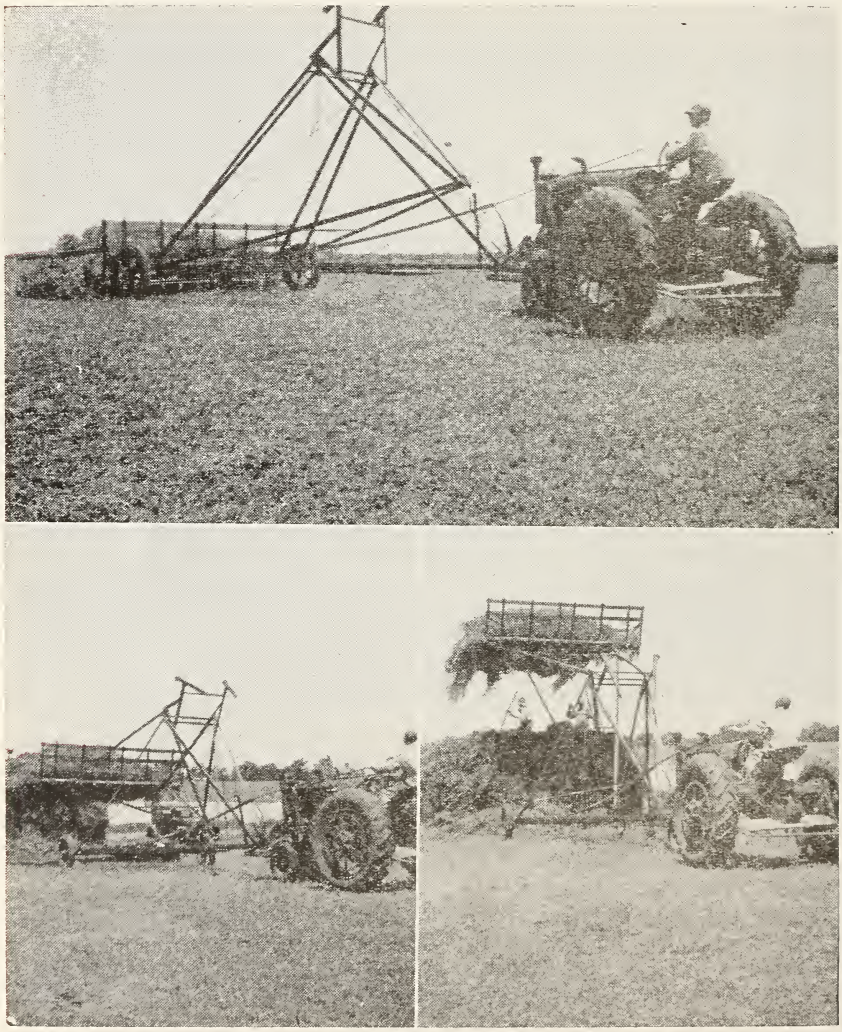

FIGURE 13.—The mechanical buckstacker in action: A, Gathering hay from windrow; B, approaching stack and raising the load; C, ready to dump load onto the stack.

Cost of harvesting hay by this method is estimated to be $1.25 per ton for the three-man crew stacking 3 tons per hour (table 10). Adding mowing and raking costs of $1.15 per ton makes a total cost of haymaking by this method of about $2.40 per ton.

This method of harvesting long loose hay was well liked by the farmers who used it. It seems probable that the use of the buckstacker will continue to increase rather rapidly in the dry hay areas of the West.

Another desirable feature of the buckstacker is that it can be used in some measure to lift hay off stacks and transport it to the feed lots. Furthermore, it is possible to use the hydraulic system of the buckstacker for other purposes, such as for operating manure loaders. In this way part of the investment and annual costs can be spread over several uses, and thereby lower the cost per ton of making hay.

The machine cost of using a buckstacker averaged about $44 in 1945. Each buckstacker handled an average of 202 tons of hay at a machine cost of 22 cents per ton. In those areas in which each handled only 75 to 95 tons, the machine cost per ton varied from 41 cents to 55 cents (table 54).

BALING HAY

There has been a substantial increase in the quantity of hay that is baled. Studies made by the Bureau of Agricultural Economics show that the proportion of hay baled in the United States increased from about 14.5 percent in 1939 to about 27 percent in 1944 and to 47 percent in 1948.[4] This increase in the baling of hay has been brought about largely by the increased use of windrow pickup balers, and one of the chief reasons for the rapid adoption of pickup balers has been the general scarcity of farm labor during the last 7 or 8 years. During this time many farmers hired custom baling because they were unable to harvest their hay and do their other farm work with the labor available. Associated with the scarcity of labor has been the high wages commanded by farm workers. With the introduction of the pickup baler the labor requirements were reduced appreciably below the requirements with stationary balers.

Two general types of balers are in use—the stationary and the windrow pickup. Hay is transported to and is hand-fed into stationary balers, whereas pickup balers are mobile—they pick up hay from windrows and bale it as they travel along.

Harvest with buckrake and stationary baler

Three types of stationary balers are now in use: (1) Those powered with animal power; (2) those powered with auxiliary motor; (3) those powered by tractor, the power usually being

[4] See footnote 1, p. 2. Also Brodell, Albert P., and Carpenter, Charles G. harvesting hay and silage. U. S. Bur. Agr. Econ. F. M. 79, 18 pp. illus. June 1950. [Processed.]

transmitted by belt but less frequently by power take-off. Some of the animal-powered balers still are operating in the South but, in general, those with mounted motors and those operated with belt power from tractors are the most numerous of the stationary balers.

In the South it is rather common for hay to be brought to stationary balers on rack wagons loaded by hand; in other parts of the country hay usually is brought to the baler by buckrakes. The latter is the typical stationary-baling operation. A practical and frequent size of crew for this operation consists of six persons distributed thus: One buckrake operator; one man to pitch the hay from the pile left by the buckrake onto the baler's feeder platform; one man to feed the hay from the platform into the baler; one to tie wires around the bales; one wire poker to return the wires to the one tying from opposite side of the bale chamber; and one man to handle the bales as they emerge from the baler. Larger crews are often used, especially with the three-wire, high-capacity stationary balers found in some irrigated sections of the West where the production of baled hay is on a commercial scale. Additions to the usual baling crew are made by adding a second buckrake, another pitcher, and another bale handler.

Investment in equipment for this method of making baled hay averaged $1,016 on the farms surveyed in 1945. If purchased new in 1947, this same equipment would cost about $1,370 including a track and power fork or sling for unloading the bales into the barn (table 20). The largest cost was for the power baler which averaged $613 when purchased. The average cost of such balers in 1947 was $750 when purchased new. The few horse-powered balers cost an average of $215 when purchased. In addition to the power baler other items of equipment in a typical set-up for this method include a tractor mower, dump rake, tractor buckrake, pitchforks, and hayrack, costing new in 1947 about $480.

The six-man crew usually baled about 1.7 tons of hay per hour, which amounts to 3.5 man-hours per ton. This labor requirement includes the hauling of hay to the baler, but does not include time for hauling and storing the bales. In many areas the bales are usually not stored while the baling is in progress. If the bales are hauled and stored at the same time the baling is done a larger crew, or two crews, would be used. In most cases this would require extra hired labor, whereas if the work is done after the baling is completed it can be done by the regular farm labor force. A small crew of three men can normally haul and store about 2.75 tons per hour when hauling from large piles of bales, and using power fork or elevator to unload at the barn. This adds 1.1 man-hours per ton to the harvesting hours and brings the total labor—for handling hay from windrow to stationary baler and then into storage—to 4.6 man-hours per ton.

The typical cost of harvesting by this method was $5.57 per ton for handling hay from windrow into storage, and the total cost of haymaking, including mowing with tractor mower and raking with dump rake, was $6.72 per ton (table 10).

TABLE 20.—*Estimated initial investment in equipment for harvesting hay, buckrake-to-stationary-baler method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Tractor mower (7 ft.)[3]	$165	$138	$170	$192
Dump rake	44	52	61	76
Tractor buckrake[4]	110	65	125	145
Pitchforks (3)	4	4	4	5
Stationary baler with mounted motor[4]	613	460	675	750
Hayrack[5]	30	25	50	60
Track and power fork[6]	50	66	109	144
Total	1,016	810	1,194	1,372

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1935–39, 1945, and 1947, are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[5] Does not include running gear. The cost data for 1935–39, 1945, and 1947, are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

[6] Taken from table 11.

The cost of harvesting baled hay by the method described is considerably higher than the cost of putting up long loose hay by any of the described methods. But baled hay must be recognized as a somewhat different commodity from loose hay in the mow. It takes less space for storing and under some conditions it has handling advantages in feeding. Generally if hay is to be sold and removed from the farm, it must be baled. Consequently, the harvesting costs for baled hay and loose hay are not comparable, unless other things are considered.

The annual machine cost of operating stationary power balers averaged about $142 in 1945. The average tonnage baled in that year was 144, making an average cost for the baler, including wire, of about $1 per ton. The largest cost was for wire, and the next largest was for depreciation. The average life of the balers was estimated at 20 years (table 55).

The yearly machine cost of using stationary balers powered by work animals was about $37 per baler in 1945, including $14 worth of wire. These balers were not used much as they baled an average of only 28 tons per baler in 1945. The cost per ton for baler and wire was $1.31 (table 55).

Harvest with pickup baler

The use of pickup balers was reported on 633 of the 1,632 farms included in the study. This is the number of farmers who reported the use of any one of the methods of harvesting hay, but many of them did not harvest their entire crop with the pickup baler. Only in the North Dakota and South Carolina areas were there no reports of harvesting with this method.

On about 40 percent of the farms that used the method, the pickup baler was used to harvest not more than 50 tons. For the most part it was custom hiring which permitted the use of pickup balers for jobs of this small size. The largest use on individual farms was reported in California where 10 farms reported baling more than 1,000 tons each, and one of these farms reported baling 5,125 tons.

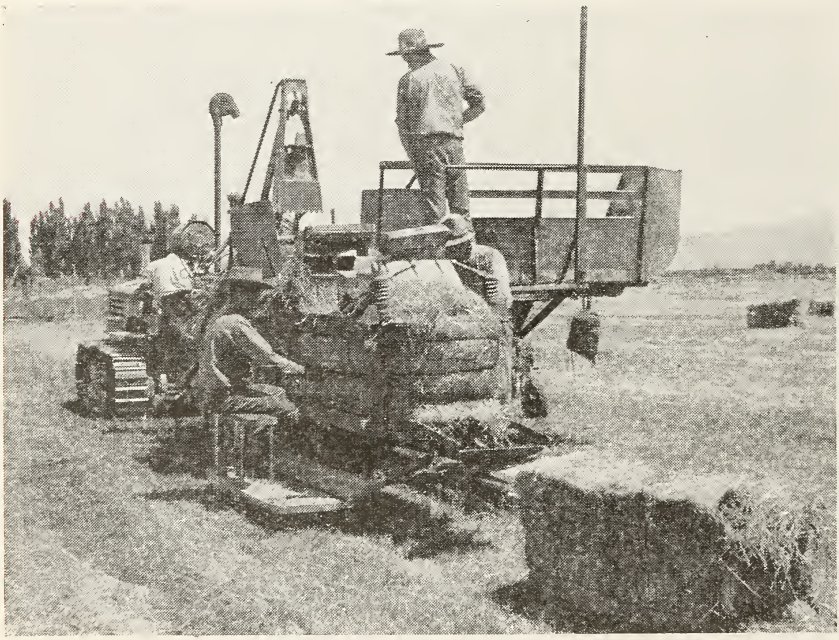

Figure 14.—A 3-wire high-capacity type of pickup baler commonly used for baling hay in the West, especially in irrigated regions. The bales produced by these balers weigh more than 125 pounds each.

There are two main types of pickup balers: (1) Those which require a crew to ride on the baler and tie the bales, (figs. 14 and 15) and (2) the fully automatic-tie baler (fig. 16). The nonautomatic type comes in different sizes; these types are usually designated by size of crew needed to operate them. Some automatic-tie pickup balers tie the bales with twine; others tie with wire. Bales of hay produced by the automatic-tie twine balers ranged from 40 to 70 pounds, with an average of 55 pounds. Bales of

straw from these balers ranged from 30 to 50 pounds and averaged about 42 pounds. Automatic balers tying with wire produced bales averaging about 70 pounds, and the weight of wire-tied bales from nonautomatic pickup balers averaged 73 pounds.

Each type of baler has its advantages. If the bales are to be shipped from the farm, wire tying is definitely superior and preferable because there is less breakage; and a ton of the heavier wire-tied bales occupies less shipping space than a ton of twine-tied bales. If the hay is to be fed on or near the farm where produced, twine-tied bales are preferred by many feeders who object to having pieces of wire in and around the feeding yard. Some

FIGURE 15.—A three-man hand-tie pickup baler baling hay. Machines of this type baled an average of 2.4 tons of hay per hour on the sample farms. Most hand-tie pickup balers are powered by a motor mounted on the baler, as is the baler here shown. Two men tie bales while the third man of the crew drives the tractor.

farmers say they like the lighter twine-tied bales because they are easier to handle and as they are less dense the hay can be safely baled and stored with a higher moisture content than if tied with wire.

The use of windrow pickup balers to collect straw from fields on which small grains have been harvested with combines is increasing. In the Corn Belt more than 750,000 tons of straw are baled annually for shipment to paper-board manufacturers. Wire-tied bales are preferred for this use.

The investment in equipment for harvesting hay by this method is large. The pickup baler is the most expensive item. Auto-

matic-tie pickup balers on the sample farms cost an average of $1,868 and three-man pickup balers cost the operators of the sample farms an average of $1,081. Tractor mowers and side-delivery rakes were nearly always used on the farms that were using pickup balers, particularly on farms whose operators owned the pickup balers. For operators who used power forks to unload bales the total investment in automatic-tie balers having mounted motors was approximately $2,250. If bought new in 1947 this equipment would have cost almost $2,900 (table 21). With the same accessory equipment the total investment for those who used three-man pickup balers was $1,466. At 1947 prices these items would have cost about $1,840 if bought new (table 22).

FIGURE 16.—An automatic-tie pickup baler baling alfalfa. Balers of this type on the sample farms baled an average of 2.6 tons per hour. The pictured baler is powered by a motor mounted on the baler, but many automatic-tie balers are powered by power take-off from the tractor.

Bale loaders, implements that mechanically pick up the bales from the ground and elevate them to a wagon or truck, are used mainly on larger hay farms in the West. These implements added an average of about $315 to the investment in equipment (table 21).

An increasing number of elevators, both home-made and purchased, are being used to unload bales into storage; there are more elevators on farms than there are bale loaders. Of the elevators on the sample farms in 1945 about 75 percent were home-made. Some of the newer type of manufactured elevators

TABLE 21.—*Estimated initial investment in equipment for harvesting hay, automatic-tie, pickup baler method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]	
		1945	1947
Tractor mower (7 ft.)[3]	$ 165	$ 170	$ 192
Side-delivery rake	140	151	196
Automatic-tie baler:			
Mounted motor[3]	1,868	2,200	2,300
Power take-off[3]	(4)	1,400	1,650
Hayrack[5]	30	50	60
Track and power fork[6]	50	109	144
Total:			
With mounted motor type baler	2,253	2,680	2,892
With power take-off type baler	(4)	1,880	2,242
Field bale loader[3]	315	400	450
Bale elevator with motor[3]	180	325	375
Total:			
With mounted motor type baler, bale loader, and elevator	2,698	3,296	3,573
With power take-off baler, bale loader, and elevator	(4)	2,496	2,923

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1945 is an estimate based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] No power take-off automatic-tie pickup balers reported on sample farms in 1945.

[5] Does not include running gear. The cost data for 1945 and 1947 are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

[6] Taken from table 11.

are adjustable so they can handle small grain, shelled corn, ear corn, or bales of hay and straw. Operators valued their elevators at an average of $180 each, including the home-made. This brought the total investment in equipment for the automatic-tie baler method plus loader and elevator to $2,698 in 1945, and to $3,573 if bought new in 1947. The comparable figures for three-man pickup balers were $1,911 in 1945 and $2,523 in 1947.

When hay is baled with pickup balers there are usually two distinct operations—the baling operation and the operation of loading, hauling, and storing. On a majority of the sample farms two separate crews did these two operations simultaneously. This was particularly true when the baling was done by custom operators; the custom operator usually supplied the baler crew and the farmer took care of the loading, hauling, and storing. The main exception was found in the commercial alfalfa areas of the far West where the custom operator often furnished both the baler

TABLE 22.—*Estimated initial investment in equipment for harvesting hay, three-man pickup baler method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]	
		1945	1947
Tractor mower (7 ft.)[3]	$ 165	$ 170	$ 192
Side-delivery rake	140	151	196
3-man pickup baler[4]	1,081	1,125	1,250
Hayrack[5]	30	50	60
Track and power fork[6]	50	109	144
Total	1,466	1,605	1,842
Field bale loader	315	400	450
Bale elevator (with motor)	180	325	375
Total with bale loader and bale elevator	1,911	2,221	2,523

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1945 is an estimate based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1945 and 1947 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[5] Does not include running gear. The cost data for 1945 and 1947 are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

[6] Taken from table 11.

crew and the crew for loading, hauling, and stacking the bales, or for loading and hauling them to the public highway or local shipping point.

The most frequently reported crew size for operating non-automatic-tie balers was three men—one man to drive the tractor and the other two, stationed on the baler, to do the tying and the chores incidental to tying. Some four-man hand-fed pickup balers were reported in the West—one man to drive the tractor, one to feed hay into the bale chamber, one to poke wires, and one to tie the wires.

Automatic-tie balers are designed to be operated by one man, but about 40 percent of the interviewed farmers actually used two men or one man and a boy. The second person rode on the baler to watch the baler's performance, especially the automatic-tie mechanism, and to warn the tractor driver in case of difficulties.

The difference in the time used to bale a ton of hay with the automatic-tie type of baler and the hand-tie type was not large. About 2.1 tons were baled per hour with the four-man type, 2.4 tons with the three-man type, and 2.6 tons with the automatic-tie type (table 23). For the farms reporting, the automatic-tie balers usually baled a ton of hay in 25 to 35 minutes. Baling with three-

man balers usually required between 1.0 and 1.5 man-hours of labor per ton, with an average of 1.2 man hours. And baling with four-man balers usually took from 1.8 to 2.2 man-hours per ton, the average being about 2 hours per ton (table 24). In general, the labor required for baling with three-man pickup balers was about 25 to 30 percent of that required with stationary balers, and automatic-tie balers required only 10 to 15 percent of the total man-hours required to bale with stationary balers.

TABLE 23.—*Average rate of baling and average weight of bales, by type of baler, sample farms, 1945*

State and area[1]	Hay baled per hour of operation				Average weight of bales				
	Pickup balers			Stationary or shock balers	Pickup balers				Stationary balers[2]
	Automatic-tie (twine)	Hand-tie (wire)			Automatic-tie (twine)		Hand-tie (wire)		
		3-man	4-man or more		Hay	Straw	Hay	Straw	Hay
	Tons	*Tons*	*Tons*	*Tons*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
New York:									
Eastern	2.6	2.8	2.1	[3]	51	40	77	57	125
Central	2.1	2.6	[3]	1.7	54	40	78	59	[3]
Western	3.1	2.3	1.7	1.6	54	42	77	58	125
Pennsylvania:									
South central	3.0	2.4	1.8	2.0	53	40	70	57	102
Northwestern	2.8	2.3	2.0	1.7	55	43	73	57	90
Minnesota	2.4	2.2	[3]	[3]	57	[3]	73	[3]	[3]
Nebraska	2.7	2.7	2.3	[3]	63	[3]	74	[3]	[3]
Virginia	2.3	2.4	[3]	1.5	56	[3]	70	[3]	90
Tennessee	2.1	2.4	2.2	1.7	[3]	[3]	73	[3]	81
South Carolina	[3]	[3]	[3]	[4]1.1	[3]	[3]	[3]	[3]	[5]
Arkansas	[3]	2.1	2.0	[6]1.6	[3]	[3]	72	[3]	72
Utah	2.4	2.0	2.0	[3]	56	43	77	57	[3]
Washington:									
Central irrigated	2.6	2.5	[7]4.5	[7]5.2	[3]	[3]	[8]102	[3]	[8]134
North coast	3.3	2.4	2.3	2.1	59	[3]	78	65	112
California	2.9	3.1	3.0	2.2	65	[3]	[8]119	[3]	[8]125
Average	2.6	2.4	[9]2.1	1.7	55	42	[9]73	59	[9]94

[1] See footnote 1, table 2.
[2] The only stationary baler reported baling straw was in the south-central area of Pennsylvania. The bales averaged about 85 pounds each.
[3] None reported, or number reporting was too small to form reliable averages.
[4] Baling rate was 1.2 tons per hour with balers powered by tractors or gasoline engines; 0.8 tons per hour with balers powered by workstock.
[5] Lespedeza averaged 74 pounds per bale and cowpeas 87 pounds per bale.
[6] About 1.6 tons per hour with balers powered by tractors or gasoline engines; and 1.2 tons per hour with balers powered by workstock.
[7] Three-wire, high-capacity balers.
[8] Usually about 85 pounds for two-wire bales and 125 to 135 for three-wire bales.
[9] Exclusive of that baled with three-wire, high-capacity balers.

TABLE 24.—*Man-labor used for baling hay with pickup balers, sample farms, 1945*[1]

State and area[2]	Type of pickup baler	Baling crew		Man-hours per ton[3]
		Average size[3]	Percentage able-bodied	
		Number	*Percent*	*Hours*
New York:				
Eastern	Automatic-tie	1.3	83.2	0.5
	3-man	3.1	76.3	1.1
	4-man	4.0	67.4	1.9
Central	Automatic-tie	1.5	86.2	.7
	3-man	3.0	96.7	1.1
	4-man	.....	.....	.....
Western	Automatic-tie	1.6	92.5	.5
	3-man	3.0	94.8	1.2
	4-man	4.0	95.2	2.2
Pennsylvania:				
South central	Automatic-tie	1.4	92.4	.6
	3-man	3.0	85.2	1.2
	4-man	4.0	46.9	2.3
Northwestern	Automatic-tie	1.6	82.0	.4
	3-man	3.0	87.2	1.2
	4-man	4.0	71.9	2.0
Nebraska	Automatic-tie	1.9	100.0	.7
	3-man	3.0	95.0	1.1
	4-man	4.0	100.0	1.9
Virginia	Automatic-tie	1.2	100.0	.5
	3-man	3.0	100.0	1.2
	4-man	.....	.....	.....
Tennessee	Automatic-tie	1.1	100.0	.5
	3-man	3.0	100.0	1.1
	4-man	4.0	100.0	2.5
Arkansas	Automatic-tie	.....	.....	.....
	3-man	3.0	(4)	1.0
	4-man	4.0	(4)	2.3
Washington:				
Central irrigated	Automatic-tie	.....	.....	.....
	3-man	3.0	(4)	1.4
	4- and 5-man	4.0	(4)	1.8
North coast	Automatic-tie	1.2	(4)	.4
	3-man	3.0	(4)	1.3
	4-man	4.0	(4)	1.7
California	Automatic-tie	1.4	100.0	.4
	3-man	3.0	96.4	.9
	4- and 5-man	4.0	99.2	1.1
All areas	Automatic-tie	1.2	[5]87.1	.5
	3-man	3.0	[5]93.1	1.2
	4-man	4.0	[5]94.6	2.0
Average	.....	2.7	[5]92.8	1.2

[1] Does not include labor for loading, hauling, and storing bales.
[2] See footnote 1, table 2.
[3] Does not include man on trailed wagon; he is included in the crew for loading, hauling and storing.
[4] Data not obtained.
[5] Based on average of those reporting.

One objection to the use of windrow pickup balers is the large amount of hard work necessary in loading, hauling, and storing the bales, especially if they are large and heavy. Schemes have been tried to overcome this difficulty. The most widely reported procedure in handling bales was to permit the bales to drop to the ground from the baler then to load them by hand onto wagon or truck. Another frequent procedure was to load the bales directly from the baler onto a wagon trailed in such a position that the baler could push the bales up a ramp from the bale chamber onto the wagon. One man on the wagon took the bales from the ramp and arranged them for hauling (fig. 17). A variation, sometimes

FIGURE 17.—Loading trailed wagon directly from baler. It is estimated that trailing a wagon as is done here reduces baling speed about 15 percent but it eliminates the strenuous labor of lifting bales from ground onto wagon.

used, was to trail a sled or platform of some kind with the baler. Bales went direct from the baler to this platform, and when the accumulation reached the desired size, they were slid off in piles in the field. From these piles the bales were more easily and quickly loaded onto wagons or trucks for hauling than if they were scattered about the field (fig. 18).

Another type of bale loader is shown in figure 19. It works somewhat like a loose-hay loader.

It was noted that when wagons were trailed the speed of baling was reduced, probably to 80 to 85 percent of the speed when wagons were not trailed.

FIGURE 18.—Loading bales on a platform dragged behind baler. Piles of bales thus accumulated save much of the time and maneuvering over the field to collect scattered bales.

Most of the baled hay was hauled to storage with trucks or tractor-drawn wagons. The average length of haul with trucks was about 0.7 of a mile, with tractors about 0.38 of a mile, and with horses about 0.31 of a mile (table 25). Trucks and tractors usually were used for hauling on the larger farms, and horses generally were used for hauling on smaller farms where the baling was usually done by custom operators.

The labor used for loading, hauling, and storing the bales averaged about 1.5 man-hours per ton. When trucks were used for hauling the average was about 1.4 man-hours per ton and when the hauling was done with tractor power it took about 1.5 man-hours per ton. Hauling with teams required about 2 man-hours of labor per ton. Even though the haul was longer on farms where trucks were used, larger loads more than offset the time required for the additional length of haul. Also, where trucks and tractors were used a higher proportion of the bales were loaded and unloaded with mechanical equipment.

FIGURE 19.—This field bale loader picks the bales up where they were dropped by the baler. It elevates them to the top of the load and eliminates much of the strenuous labor associated with the loading of bales from the ground.

In general, it takes about the same length of time to load a ton of hay with a bale loader as it does to load it by hand, but the size of crew used with a bale loader is often smaller than that used to load bales by hand, and the bale loader makes the loading job easier. Usually three or four men made up the crew. One man is required to drive the truck or tractor and one or two men are needed to arrange the bales on the load. Some types of loaders require a man to be on the ground to guide bales into the loader or to put them into position to be readily picked up by the loader.

More hours of labor were used for unloading a ton of baled hay with elevators than with forks or slings. One reason is that the reported bale elevators were on the larger farms where storage space and travel distance were relatively large. As farmers gain more experience in using bale elevators the labor can be reduced. One way of materially reducing man-hours per ton is to cut doors at intervals along the side of the storage place if it is large and move the elevator from door to door instead of moving bales from one elevator point to the entire mow area. Bale elevators will handle about 5 or 6 tons of hay per hour if kept running, but usually a three-man crew handled about 2.5 tons per hour. At normal speed of operating the elevator at least two men are required in the barn to keep bales out of the way (fig. 20). This is a difficult job, especially when heavy bales are moved long distances or are placed in high stacks.

TABLE 25.—*Man-labor used for loading, hauling, and storing hay baled with pickup balers, sample farms, 1945*

State and area[1]	Hauled with	Average distance hauled	Crew for loading, hauling and storing		Man-hours per ton
			Average size	Percentage able-bodied	
		Miles	*Number*	*Percent*	*Hours*
New York:					
Eastern	Tractors	0.45	3.7	88.5	1.4
	Trucks	.78	4.0	93.1	1.3
	Horses	.31	2.6	100.0	1.5
Central	Tractors	.32	3.3	97.7	1.5
	Trucks	.43	2.7	100.0	1.3
	Horses	.34	4.4	100.0	2.0
Western	Tractors	.50	3.0	96.5	1.3
	Trucks	.73	2.9	96.3	1.3
	Horses	.41	2.8	100.0	1.3
Pennsylvania:					
South central	Tractors	.34	3.8	86.6	1.4
	Trucks	1.13	4.3	91.0	1.8
	Horses	.12	3.4	70.6	2.3
Northwestern	Tractors	.37	3.7	85.3	1.6
	Trucks	1.27	4.9	76.8	1.7
	Horses	.25	4.3	89.4	1.8
Nebraska	Tractors	.39	3.4	92.7	1.4
	Trucks	.34	4.1	89.7	1.6
	Horses	.26	3.8	92.1	1.7
Virginia	Tractors	.20	4.2	100.0	1.7
	Trucks	.50	5.0	100.0	1.7
	Horses	.13	4.0	100.0	2.0
Tennessee	Tractors	.36	4.2	100.0	3.1
	Trucks	.38	3.0	100.0	3.0
	Horses	.21	3.9	100.0	3.3
Arkansas	Tractors	(2)	4.2	(2)	2.4
	Trucks	(2)	6.3	(2)	3.2
	Horses	(2)	4.5	(2)	3.4
Washington:					
Central irrigated	Tractors	.39	3.2	(2)	1.1
	Trucks	.96	3.1	(2)	1.2
	Horses	.50	5.0	(2)	1.2
North coast	Tractors	.41	3.2	(2)	1.9
	Trucks	1.14	4.1	(2)	1.5
	Horses	.33	4.0	(2)	2.2
California[3]	Tractors	.34	2.3	95.3	.4
	Trucks	.45	2.7	94.1	.4
	Horses	.....	.....	.....	.....
All areas	Tractors	[4].38	3.4	[4]91.9	[5]1.5
	Trucks	[4].70	3.5	[4]92.4	[5]1.4
	Horses	[4].31	3.8	[4]96.4	[5]2.0
Average	.....	[4].50	3.5	[4]92.6	[5]1.5

[1] See footnote 1, table 2.

[2] Data not available.

[3] Most of this was not stored in barns. The labor shown is for hauling the hay to the roadside or edge of the field where much of it was loaded by custom haulers, many of whom were transporting it to the dairy area of the West Coast.

[4] Based on average of those reporting.

[5] Average does not include data for California as they are not comparable with those for other areas, because in many cases the bales were left stacked in the fields in California.

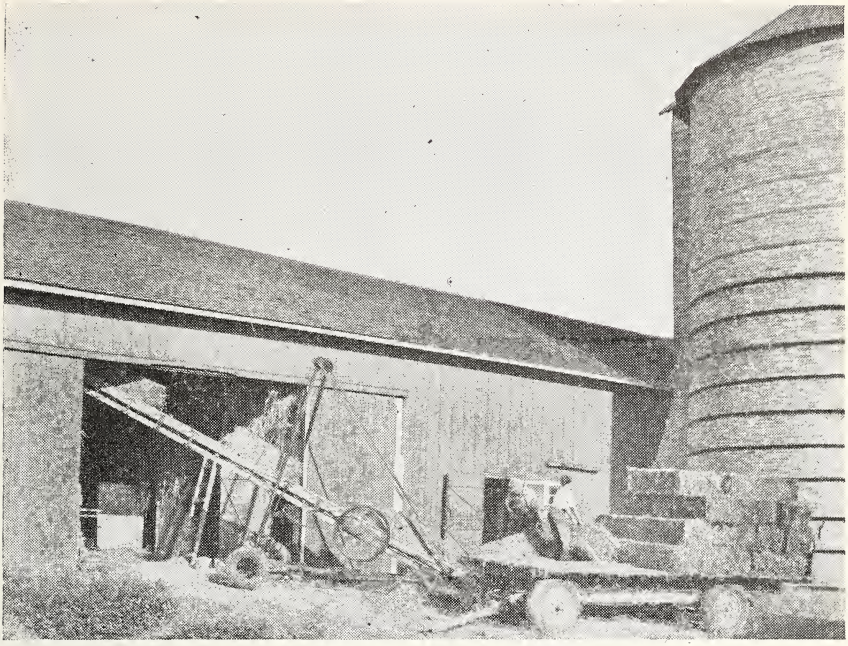

FIGURE 20.—A bale elevator such as this will elevate up to 6 tons of hay per hour, depending on the speed of operation. Two men will be required in the mow to take care of the hay elevated at the rate of 2.5 to 3 tons per hour.

Forks or slings are used on many farms to unload bales and draw them into the mow. The forks or slings carry from 4 to 10 bales per load, depending upon how substantial the track installation is (fig. 21). A layer of loose hay or of bales is usually placed on the loft floor before the fork or slings are loaded to capacity. This is done to avoid breaking the loft floor when the bales are dropped from fork or sling. Formerly, bales drawn into the barn were generally stacked in an orderly fashion, but now many farmers leave the bales in a helter-skelter pile just as they fall (fig. 22). Most barns were designed and built to hold a full mow of loose hay, but not a full mow of hay that has been compressed into bales. Only a few barns have been sufficiently reinforced to stand up under a full mow of baled hay. With the helter-skelter method the danger of overloading mows is practically eliminated and the labor required to stack and arrange the bales is entirely eliminated.

Average baling cost on the sample farms in 1945 was estimated at $1.70 per ton of hay baled with automatic-tie balers and $2.19 per ton baled with three-man balers. Loading, hauling, and storing bales cost $1.52 per ton. This brings the total cost of handling hay from windrow into storage to $3.22 per ton for the automatic-tie baling method and $3.71 per ton for the hand-tie baling method. The cost of mowing with tractor-drawn mower and cost of

FIGURE 21.—Here, tines of the grapple fork are placed in position to lift nine bales. By this means, unloading with power forks can be done with a minimum of strenuous labor and with a small crew, especially if the hay is not stacked in the barn.

raking with tractor-drawn side-delivery rake was $1.11 per ton, making the total cost of haymaking $4.33 per ton when handled with automatic-tie pickup balers, and $4.82 per ton when baled with three-man pickup balers. These costs are based on an average use of 738 tons per automatic-tie baler in 1945 and 432 tons per three-man baler. These figures represent the average use of these balers on sample farms in 1945. Estimated costs per ton of baling hay for three different levels of annual use for both automatic-tie and three-man pickup balers are shown in tables 26 and 27.

Baling hay, even with an automatic-tie pickup baler, is not a low-cost method of harvesting hay, but other considerations, such as mentioned in the section on stationary baling, often outweigh the cost factor. In general, the farmers who use the pickup baling method were well satisfied with it, but many of those using hand-tie balers indicated that they planned to change to automatic-tie balers. A pressing need in connection with pickup baling is to find low-cost ways of reducing the man-labor requirements for loading and storing bales.

Itemized statements of the machine costs, including ties, of using three types of pickup balers, bale loaders, and bale elevators, are shown in tables 56 to 60, inclusive. These costs are for the reporting farms and are the bases for estimating costs of

baling, and for handling the bales when different quantities of hay are baled, as shown in tables 26 and 27.

CHOPPING HAY

Only a small part of the hay crop is chopped, but the practice of chopping is increasing. Chopped hay takes about half the storage space required by long loose hay. Well-built, strong mows are necessary to carry the additional weight. When blowers are used for storing the chopped hay it can be stored more uniformly and with less labor than is necessary with baled or loose hay.

This study pertains to hay that was chopped in the fields or brought to the place of storage and chopped at harvest time. Two general methods were used—chopping with stationary choppers and chopping with field pickup choppers. Considerable hay, especially in the Mountain and Pacific Coast States, is stored as long loose hay and then is chopped before being fed, but the methods and costs given here do not include this practice.

FIGURE 22.—Many farmers now drop the bales from the grapple fork and allow them to fall helter-skelter inside the barn. Leaving the bales in this position has many advantages, the more important of which are: It eliminates the strenuous labor necessary when bales are stacked inside the barn; it lessens the danger of overloading and consequent breaking of the barn structure; and it permits air to mix with the bales, thereby promoting better drying and curing.

TABLE 26.—*Estimated cost of handling one ton of hay from windrow into storage, automatic-tie, pickup baler method, by annual use of baler, 1945*

Item	Cost per ton baled		
	100 tons per year	200 tons per year	500 tons per year
Baling:			
Use of baler	$2.70	$1.50	$0.95
Twine—3.2 pounds at $0.17 per pound	.54	.54	.54
Power—0.38 hour at $0.65 per hour	.25	.25	.25
Labor—0.5 man-hour at $0.70 per hour[1]	.35	.35	.35
Total	3.84	2.64	2.09
Loading, hauling, and unloading—			
Use of equipment:	.06	.06	.06
Power:			
Loading and hauling—0.43 hour at $0.65 per hour	.28	.28	.28
Unloading—0.2 hour at $0.65 per hour	.13	.13	.13
Labor—1.5 man-hours at $0.70 per hour	1.05	1.05	1.05
Total	1.52	1.52	1.52
Grand total	5.36	4.16	3.61

[1] The average baling rate per baler was approximately 2.5 tons per hour of operation. This was 0.4 man-hour labor per ton if the baler were operated by only one man; however, enough balers were operated by two-man crews to bring average labor for baling with all automatic-tie balers up to 0.5 man-hour per ton.

HARVEST WITH STATIONARY CHOPPER

Ensilage cutters, adjusted to handle hay, are frequently used for stationary chopping (fig. 23). On the farms studied hay was brought to the choppers by buckrakes, or on wagons that had been loaded with hayloaders. The average reported investment in equipment for harvesting hay by this method, when buckrakes were used for hauling, was $809; when hay loaders and wagons were used, the investment was $862 (table 28). Of the latter amount $390 was for the stationary chopper, but in all areas except the far west only about 45 percent of the total annual use of the chopper was represented by its use for chopping hay and hay crops for silage. In 1947 a new silage chopper would have cost $445, and all of the machines for harvesting chopped hay by this method would have cost $983 with buckrake and $1,111 with hay loader and hay rack.

On the limited number of farms on which this method was reported, a crew of three men was commonly used when the hauling was done on wagons, and the average labor requirements was 2.7 man-hours per ton. When the hay was hauled with buckrakes, a two-man crew was most frequently used and the average labor requirement was 2.1 man-hours per ton.

TABLE 27.—*Estimated cost of handling one ton of hay from windrow into storage, three-man pickup baler method, by annual use of baler, 1945*

Item	Cost per ton baled		
	100 tons per year	200 tons per year	500 tons per year
Baling:			
Use of baler	$ 1.10	$ 0.65	$ 0.35
Wire[1]	.54	.54	.54
Power—0.42 hour at $0.65 per hour	.27	.27	.27
Labor—1.2 man-hours at $0.70 per hour	.84	.84	.84
Total	2.75	2.30	2.00
Loading, hauling, and unloading— Use of equipment:	.06	.06	.06
Power:			
Loading and hauling—0.43 hour at $0.65 per hour	.28	.28	.28
Unloading—0.2 hour at $0.65 per hour	.13	.13	.13
Labor—1.5 man-hours at $0.70 per hour	1.05	1.05	1.05
Total	1.52	1.52	1.52
Grand total	4.27	3.82	3.52

[1] Based on 1945 wire cost of $5 per package of 500 wires.

The cost of harvesting with this method was estimated at $2.83 per ton when hayloaders, wagons, and stationary choppers were used, and $2.26 per ton when buckrakes and stationary choppers were used. With a mowing cost of $0.60 per ton and a raking cost with side-delivery rake of $0.51 per ton the total cost of making hay was $3.94 per ton if hauled on wagons and $3.37 per ton if brought to the chopper by buckrake (table 10).

A detailed estimate of machine costs for stationary choppers is shown in table 61. The 88 silage cutters cost an average of about $400 when bought by the farmers. They were used an average of 88 hours, in 1945, at an operating cost of 62 cents per hour of chopper use.

HARVEST WITH PICKUP CHOPPER

Use of the pickup chopper, sometimes called field chopper, for putting up hay is fairly new. More than half of the choppers reported in this study had been used only one or two seasons.

Almost 60 percent of the users of pickup choppers harvested less than 150 tons of hay with their chopper. The largest number of choppers was used to harvest between 50 and 100 tons. In the California area nine users reported the chopping of more than 1,000 tons each.

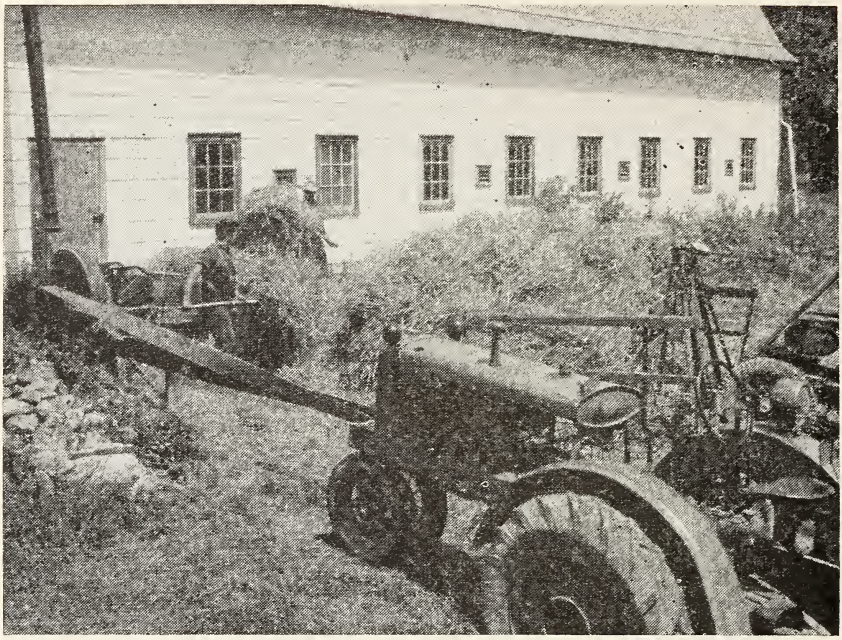

FIGURE 23.—In stationary chopping the material may be buckraked to the stationary chopper and pitched by hand into the chopper, which is ordinarily a standard ensilage cutter adjusted to handle hay. If the bucking distance is short enough, two men are required to handle the hay at the chopper. A two-man crew ordinarily chopped slightly more than 1 ton of hay per hour by this method.

The pickup chopper is a high-cost machine and when only a little work is done its cost per ton of product is high. However, most of the pickup choppers were used to chop corn and other crops in addition to hay. This was true generally in the eastern areas where hay tonnages per farm were relatively small. About 25 percent of the operating time of the pickup choppers in 1945 was used to chop crops other than hay and grass silage (tables 62 and 63). The tables also contain itemized machine costs involved in using the two types of field pickup choppers—power take-off and mounted-motor types. Table 64 contains the same type of information on the use of blowers for elevating chopped material, including grass silage.

The mounted-motor type of chopper generally has a higher capacity than the power take-off type. This is especially important to farmers who use their field chopper on row crops or hay crops for silage. Power take-off pickup choppers have proved to be satisfactory for chopping hay.

The pickup chopper method is one of the most highly mechanized methods of harvesting hay. It uses much complementary equipment, requiring a heavy investment, and hence is practical only on large farms or where much custom work is done.

TABLE 28.—*Estimated initial investment in equipment for harvesting hay, stationary chopper method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]		
		Average 1935–39	1945	1947
Tractor mower (7 ft.)[3]	$165	$138	$170	$192
Side-delivery rake	140	129	151	196
Tractor buckrake[4]	110	65	125	145
Hay loader	133	133	170	213
Hayrack[5]	30	25	50	60
Pitchforks (3)	4	4	4	5
Stationary chopper	390	311	370	445
Total:				
With buckrake	809	647	820	983
With loader and wagon	862	740	915	1,111

[1] Averages of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The cost data for 1935–39 and 1945 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1935–39, 1945, and 1947, are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

[5] Does not include running gear. The cost data for 1935–39, 1945, and 1947, are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

Farm operators reported that they had paid an average of $1,600 each for their mounted-motor type of pickup chopper and $750 each for their power-take-off type. These were bought over a period of time and some may have been bought as used machines. In 1947, the average pickup chopper, bought new with mounted motor cost about $2,200 and the new chopper operated with power-take-off about $1,250 (table 29).

On farms using pickup choppers the mowing was ordinarily done with tractor-mowers and the raking with tractor-drawn side-delivery rakes. Average investment reported by the farmers was $165 per tractor-mower and $140 per side-delivery rake. At least two trucks or trailers for hauling chopped material to storage were required to keep the chopper running continuously. The equipment for hauling included trucks with ordinary box beds, dump trucks, home-made trailers, and special-built covered trailers or vans sometimes equipped with power-take-off devices for unloading. Investment in two trailers was most frequently reported at around $150; but investment per farm ran up to $1,000 or more for the infrequently reported special-built hauling rigs. Blowers were normally used to move the chopped hay from trailer into

TABLE 29.—*Estimated initial investment in equipment for harvesting hay, pickup chopper method*

Item	Average for farms using this method[1]	Purchase price of new equipment[2]	
		1945	1947
Tractor mower (7 ft.)[3]	$ 165	$ 170	$ 192
Side-delivery rake	140	151	196
Pickup chopper:			
Mounted motor[4]	1,600	2,000	2,200
Power-take-off[4]	750	1,000	1,250
Trailers (2)[4]	150	200	250
Blower and pipe[4]	283	290	310
Pitchforks (3)	4	4	5
Total:			
With mounted-motor chopper	2,342	2,815	3,153
With power-take-off chopper	1,492	1,815	2,203

[1] Average of purchase prices of both new and used machines bought in 1945 or in earlier years.

[2] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[3] The cost for 1945 is an estimate based on data obtained in the survey and on special reports from dealers in farm machinery.

[4] The cost data for 1945 and 1947 are estimates based on data obtained in the survey and on special reports from dealers in farm machinery.

storage. Average investment in the blower, with necessary pipe, was $283.

The total initial investment in haymaking machinery reported by the farmers who used the pickup chopper method with the mounted-motor type of chopper was $2,342 and for those using the power-take-off type $1,492. If this complete set of equipment had been purchased new in 1945, the total initial investment would have been $2,815 for the mounted-motor type of chopper, and $1815 for the power-take-off type; if purchased new in 1947 the total investment would have been $3,153 for the mounted motor pickup chopper and $2,203 with the power-take-off chopper. For an additional cost of about $300 in 1945 and $350 in 1947 a row-crop attachment could have been bought to go with the chopper. This attachment permits the chopper to be used on row crops for silage, thereby insuring greater annual use of the machine, which reduces the cost per ton of material chopped.

A crew of four men was rather common for handling hay by this method (fig. 24). A typical crew consisted of: one man who operated the tractor and chopper, two men who hauled chopped material, and one man who was located at the blower. Four-man crews stored approximately 3.5 tons of hay per crew hour. At this rate, it took about 1.1 man-hours to handle a ton of hay from windrow into storage by the pickup chopper method (table 10).

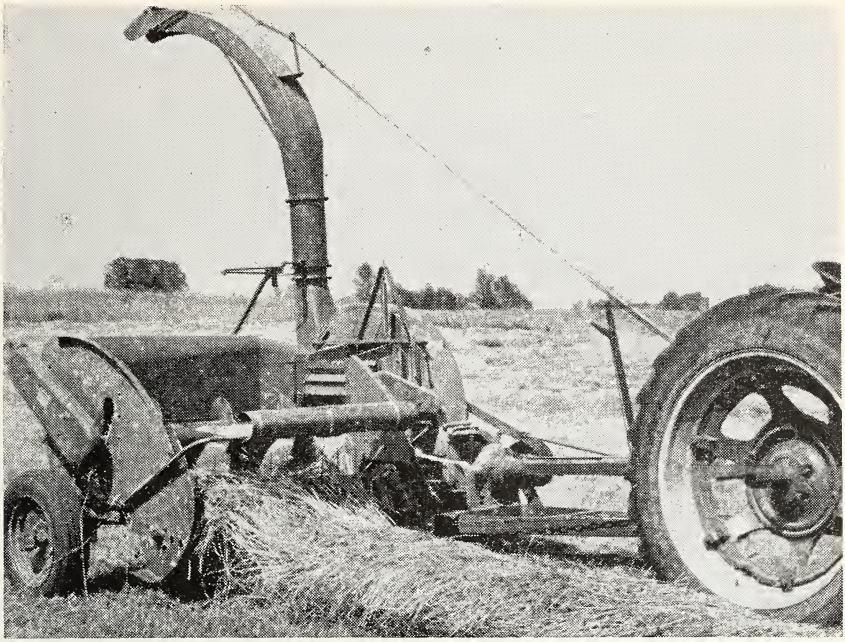

FIGURE 24.—Power-take-off pickup chopper working on dry hay. Four-man crews—1 man operating the tractor and chopper, 2 hauling the chopped hay, and 1 operating the blower at the barn—handled approximately 3.5 tons of hay per hour.

The cost of chopping and storing hay at the rate of 3.5 tons per hour with a mounted-motor type of pickup chopper was $2.23 per ton. The major items were the chopper cost of $2.10 per hour of operation or $0.60 per ton, and the man-labor cost of $0.77 per ton. The addition of $0.60 for mowing with tractor-mower and $0.51 for raking with tractor-drawn side-delivery rake brings the total cost per ton up to $3.34 (table 10).

When a power-take-off chopper was used, the cost of chopping and storing was $1.91 per ton. Assuming that the power-take-off chopper also handled 3.5 tons per hour, the chopper cost was $0.99 per hour and $0.28 per ton. Other items of cost were the same as those for handling hay with the mounted-motor type. The total cost of making hay with a power-take-off chopper was $3.02 per ton.

Operators indicated that the small number of man-hours of labor and the small amount of strenuous work required per ton of hay were the main advantages of the pickup chopper method of harvesting. Some farmers said that their livestock cleaned up chopped hay better than they did long hay which means less waste.

The most frequently mentioned disadvantage of the pickup chopper method was the high cost of a chopper and complementary equipment. Another consideration was the high cash operating

expense. The survey seemed to show that when the pickup chopper method was used the hay was left in the field to cure longer than when harvested by any other method used in the area. One reason for this is that it is necessary that chopped hay be very well cured before it is stored, as it settles into a much denser mass than does long loose hay. Because it is left longer in the field hay harvested with a pickup chopper is more likely to be damaged by weather. This may limit the use of this type of chopper for hay harvest in some areas. It is not, however, a problem in the drier areas where the chopped hay is sometimes stacked in the open (fig. 25).

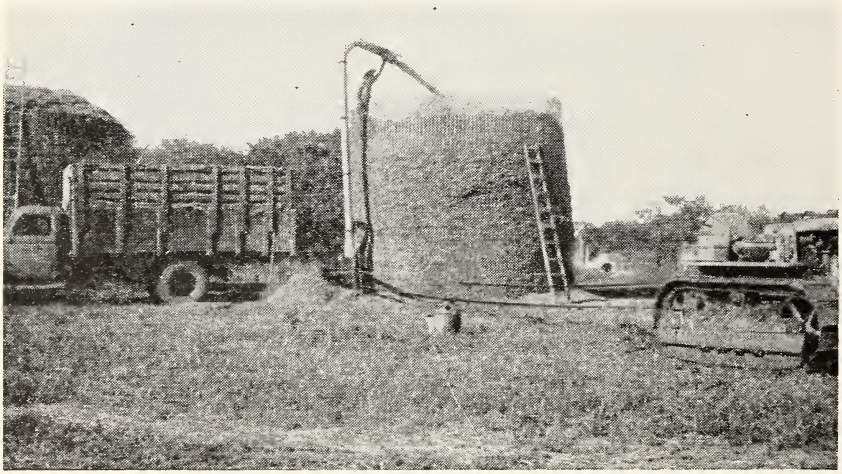

FIGURE 25.—Illustration shows hay, chopped by pickup chopper and delivered by truck, being blown into stack.

CUSTOM WORK IN HAYMAKING

In most areas, custom hiring played an important part in harvesting the hay crop. Occasionally mowing, raking, or buckraking were done on a custom basis, but baling and chopping were hired more frequently. Approximately 19 percent of all the farms hired baling done by windrow pickup balers. This percentage varied from the low figures of 2.8 percent for the central irrigated area of Washington and 4.3 percent for the Utah farms, to the extreme high of 61.7 percent for the Nebraska farms (table 30). Some baling with stationary balers on a custom basis was reported, but the amount of such work reported by the sample group studied was too small to determine reliable averages for that operation.

The study shows that there was no appreciable difference between the rates charged for baling with automatic-tie pickup balers and rates for hand-tie pickup balers (table 31). The custom charge for baling was usually made on a per bale basis. The custom operator usually furnished the baling crew and the wire

or twine and other supplies. Under these conditions the most common charge reported in 1945 was 13 cents per bale. On a per ton basis the average charge for custom baling was about $3.90.

Custom charges for baling are substantially higher than the computed costs of baling for those farmers who owned balers, as shown in tables 26 and 27. However, custom operators may have higher costs than farmers who own their balers. Time used for moving from place to place, time lost because of rains and storms, and higher wages for help in some cases, contributed to higher costs.

TABLE 30.—*Custom baling with pickup balers, sample farms, 1945*

State and area[1]	Using custom-hired pickup balers			Balers owned by farm operators and hired out	
	Percentage of all farms	Hay baled per farm	Percentage of all hay harvested	As a percentage of balers owned	Hay baled per baler
	Percent	*Tons*	*Percent*	*Percent*	*Tons*
New York:					
Eastern	17.2	30	4.4	39.0	246
Central	19.6	38	5.4	19.6	346
Western	23.9	34	6.7	25.9	366
Pennsylvania:					
South central	26.0	31	14.4	37.0	178
Northwestern	30.8	29	10.2	26.9	254
Wisconsin	13.0	16	4.7	(2)	(2)
Minnesota	15.3	15	7.0	9.7	21
Nebraska	61.7	48	27.7	12.8	838
Virginia	32.8	48	16.6	3.4	350
Tennessee	31.4	62	22.2	7.1	476
Arkansas	8.3	50	7.4	6.3	48
Utah	4.3	53	3.2	15.9	340
Washington:					
Central irrigation	2.8	57	.3	4.7	550
North coast	15.3	52	4.1	6.3	762
California	30.6	373	23.4	9.2	946
Average	18.8	[3]38	9.0	14.5	[3]377

[1] See footnote 1, table 2.
[2] Not obtained.
[3] Excluding California.

In the California area, 3.7 percent of all the hay harvested was handled by custom-hired pickup choppers. This is the largest percentage so handled in any of the 17 areas but lesser quantities were custom-chopped in several areas, principally in the areas of Minnesota, Nebraska, Utah, and the north coast of Washington. The percentages of the chopped hay that were custom-chopped on the farms studied are as follows: Minnesota, 1.1 percent, Nebraska, 0.5 percent, Utah, 0.2 percent, north coast area of Washington, 0.5 percent. Custom charges for chopping hay with field pickup choppers could not be reliably determined from this study.

TABLE 31.—*Size of crew furnished by custom operator and charge per ton for custom baling, sample farms, 1945*

State and area[1]	Custom baling with pickup baler				
	Automatic-tie		Hand-tie		
	Men furnished by operator	Charge per ton[2]	Men furnished by operator		Charge per ton[2]
			3-man baler	4-man baler	
	Number		*Number*	*Number*	
New York:					
Eastern	1.3	$4.23	2.6	3.9	$4.09
Central	1.3	4.00	2.8	(3)	3.58
Western	1.5	3.88	2.4	3.7	3.73
Pennsylvania:					
South central	1.3	3.50	2.7	(3)	3.64
Northwestern	1.4	3.15	2.0	4.0	3.46
Minnesota	(3)	(3)	1.9	(3)	3.02
Nebraska	1.5	3.30	3.0	(3)	3.49
Virginia	1.3	3.65	(3)	(3)	(3)
Tennessee	1.3	4.08	2.8	3.7	4.05
Arkansas	(3)	(3)	2.8	3.6	4.02
Utah	1.0	4.00	3.0	(3)	4.00
Washington:					
Central irrigation	1.3	4.90	3.0	4.0	4.95
North coast	1.3	4.35	2.6	4.0	4.30
California	1.5	4.40	2.9	4.0	4.50
Average	1.4	3.90	2.6	3.9	3.93

[1] See footnote 1, table 2.

[2] This cash charge does not allow for the baling-crew workers furnished by the farmers who hired the baling done.

[3] None reported, or number reporting was too small to form reliable averages.

ENSILING HAY CROPS

The use of hay crops for ensiling has increased rapidly, especially since 1945. The production of grass silage has become important in the Northeast and in the coastal areas of the Pacific Northwest, and it is used to a lesser extent in dairy areas of the Lake States. In these areas climatological conditions make the proper curing of hay difficult.

Information on the use of hay crops for grass silage was not generally gathered in the haymaking survey of 1945. The following data on harvesting grass silage was gathered by a special survey of 30 dairy farms in northeastern Pennsylvania, in June 1948. In this area apparently 15 or 20 percent more grass silage was harvested in 1948 than in 1947. Preservatives were added to the silage by about 5 percent of all farms who harvested grass silage in the area. All but 1 of the 30 interviewed farmers used the "wilt method" in preparing the crop for the silo. That is, they allowed the cut material to lie in the windrow until it had wilted to approximately 65 percent moisture content. The ma-

terial was then either loaded with a loader and hauled to a stationary ensilage cutter or it was chopped from the windrow with a field pickup chopper.

Harvest with loader and ensilage cutter

On all the farms visited regular tractor mowers were used to cut hay crops that were to be ensiled. These mowers were equipped with windrowing attachments so that the mowing and windrowing were done in one and the same operation. Side-delivery rakes are sometimes used when windrow attachments are not used, but they have the disadvantage that they turn stones into the windrow when the hay fields are rocky—a condition that is characteristic of Pennsylvania farms. Stones in the windrow are readily picked up and taken into the chopper where they can cause great damage to the chopping mechanism.

Although grain binders were not used to handle hay crops cut for silage on the farms visited, crops like timothy, soybeans, sweetclover, sudan, and small grains, can be handled conveniently with binders. The binder has been used some in other areas and it is known that loading bundles and pitching them into an ensilage cutter requires less hard work than loading and pitching loose green material.

When the loader and ensilage cutter method was used the list of complementary equipment included the mower and windrowing attachment, a hayloader, one trailer or hayrack, and an ensilage cutter. The cost per ton of this equipment was relatively low because the equipment had a relatively high annual use. The loader was commonly used on hay crops as well as on grass-silage crops, and the ensilage cutter was used on silage corn on most farms and for chopping straw on many farms in this area. The estimated total cost of the equipment needed to harvest grass silage by this method, if the equipment were purchased new in 1945, would have been about $790, and if bought in 1947 it would have been about $945 (table 32).

Three was a typical crew for the farms harvesting grass silage by this method. The members of the crew spent an average of about 7 hours a day working on grass silage, and they stored an average of about 2.6 tons of silage per hour, or approximately 18 tons per day (fig. 26). About 1.28 man-hours per ton of unsettled silage were used to handle the material from windrow into silo. Mowing and windrowing required about 0.75 man-hour per acre, or approximately 0.12 man-hour per ton of grass silage.

With the loader and ensilage-cutter method, the cost of harvesting grass silage was estimated at $1.56 per ton, including the mowing and windrowing cost (table 33). Man labor accounted for about 52 percent of the total harvest cost, power 28 percent, and machinery 20 percent.

The main advantage of using the loader and ensilage-cutter method of harvesting grass silage is the low investment for machinery and equipment (compare table 33 with table 34). The major disadvantage is the heavy work involved in loading and unloading the green material.

TABLE 32.—*Estimated initial investment in equipment for harvesting grass silage, loader-ensilage cutter method*

Item	Purchase price of new equipment[1]		
	Average 1935–39	1945	1947
Tractor mower (7 ft.)[2]	$138	$170	$192
Windrowing attachment[3]	18	25	30
Hay loader	133	170	213
Hayrack[4]	25	50	60
Pitchforks (3)	4	4	5
Ensilage cutter	311	370	445
Total	629	789	945

[1] These are U. S. average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[2] The average cost for 1935–39 is not exactly comparable with the costs for later years as some of those earlier machines were ground-driven. The data for 1935–39 and 1945 are based on data obtained in the survey and on special reports from dealers in farm machinery.

[3] Estimates based on reports from farm-machinery dealers and on price listings in retail catalogs.

[4] Does not include running gear. Costs are estimates based on prices of rough lumber and farm-wage rates, and on estimates of the quantities of materials and labor used in building the hayracks.

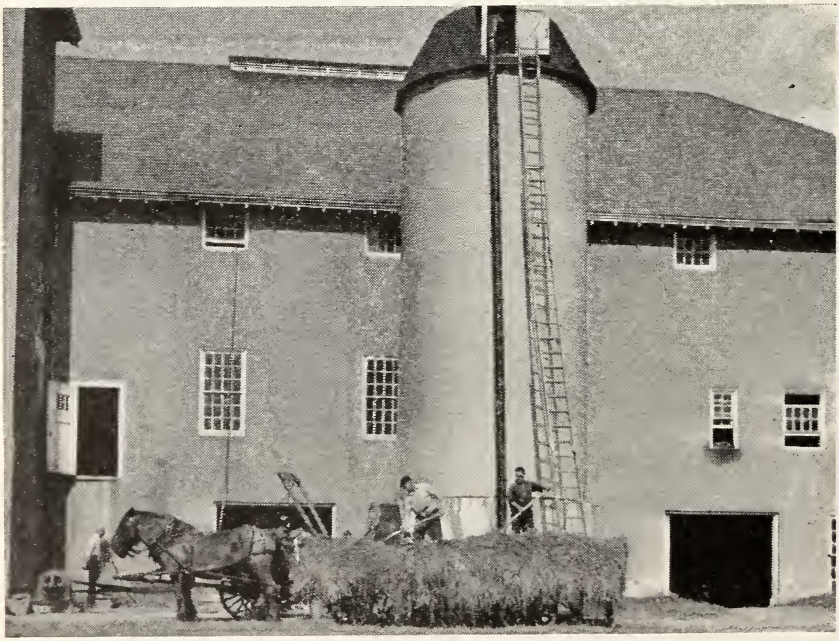

FIGURE 26.—Grass silage harvested by the loader and ensilage-cutter method. A crew of three, with average haul, can ensile about 2.6 tons per hour by this method. Pitching the green material from wagon into the ensilage cutter, as above, is hard work.

TABLE 33.—*Physical requirements and estimated cost of harvesting grass silage, loader-ensilage cutter method*[1]

Item	Cost per hour	Per ton of unsettled silage		Per ton of dry matter when ensiled	
		Time required	Cost	Time required	Cost
Machine:		*Hours*		*Hours*	
Mower and windrowing attachment	$0.40	0.12	$0.05	0.34	$0.14
Loader (heavy duty)	.60	.16	.10	.46	.29
Hayrack	.02	.39	.01	1.12	.03
Ensilage cutter	.70	.16	.12	.46	.34
Power (tractor)	.65	.69	.45	1.97	1.29
Man labor	.65	1.28	.83	3.66	2.37
Total cost			1.56		4.46

[1] Based on a per acre yield of 6 tons of green material at 65-percent moisture. Data gathered in special survey of 30 dairy farms in northeastern Pennsylvania, 1948.

HARVEST WITH PICKUP CHOPPER

This method is suitable for use on farms which produce a large tonnage of silage each year or for farmers who do considerable custom work. Excluding one exceptionally large farm, the average quantity of silage handled per machine on the sample farms was 385 tons in 1947—270 tons of grass silage and 115 tons of corn silage.

In all but one case in which pickup choppers were used for grass silage, the hay crops were cut and windrowed with tractor mowers having windrowing attachments. In addition, the equipment normally used to harvest grass silage included two trailers to haul chopped material from field to silo, mechanical devices to unload trailers, the pickup chopper with mounted motor, and a blower to move the chopped material into the silo. Table 34 gives the estimated investment in this equipment if purchased new in 1945 and in 1947.

All but one of the farms that had a pickup chopper had some kind of mechanical unloading device. Such devices used with trailers consisted of a canvas which carried the load to the rear while it was wound on a pipe mounted on the rear of the trailer and was geared to a small gasoline engine or electric motor. This arrangement apparently worked better than such arrangements as putting a false endgate in front of the load and pulling it to the rear to unload the green material.

A four-man crew was ordinarily used to ensile hay crops by this method—one man operating tractor and chopper, two men hauling and unloading, and one man at the silo operating the blower and helping to unload. When pickup choppers were used the quantity stored ranged from 5 to 13 tons per hour, with an average rate of about 10 tons per hour. The fastest operation was accomplished when trucks were used for hauling. That was mainly because the tractor was not slowed down by having to

TABLE 34.—*Estimated initial investment in equipment for harvesting grass silage, pickup chopper method*

Item	Purchase price of new equipment[1]	
	1945	1947
Tractor mower (7 ft.)	[2]$ 170	$ 192
Windrowing attachment[3]	25	30
Trailers (2)[2]	200	250
Unloading devices (2)[4]	200	250
Pickup chopper (mounted motor)[2]	2,000	2,200
Blower and pipe[2]	290	310
Pitchforks (3)	4	5
Total	2,889	3,237

[1] These are United States average prices paid by farmers during the year specified and, except where noted, are taken from Agricultural Prices, Bureau of Agricultural Economics.

[2] Estimates are based on data obtained in the survey and on special reports from dealers in farm machinery.

[3] Estimates based on special reports from farm machinery dealers and on price listings in retail catalogs.

[4] Equipment for unloading 2 trailers includes: 2 sets of canvas, one gear box, and one gasoline or electric motor. Estimates of cost are based on data obtained in the special survey.

pull an extra load behind the chopper. All farms using tractor power for hauling trailed a trailer behind the chopper and used only one tractor for pulling the trailers to the silo.

The speed at which the green material could be transported from the chopper was often the limiting factor in the speed of the entire operation. Under favorable conditions the choppers chopped the usual 3-ton load in 12 to 15 minutes. Unloading was done very quickly in most cases; the time required to unload a 3-ton load ranged from 5 to 12 minutes. When no unloading devices were used more time was required for unloading.

The man-labor requirements ranged from about 0.3 man-hour to 0.6 man-hour per ton with an average of approximately 0.4 man-hour per ton. This is approximately one-third as much time as that used with the loader-ensilage cutter method.

Labor was valued at $0.65 per hour in calculating the cost of harvesting by this method. As 385 tons of silage were handled per year on the sample farms, the estimated cost of harvesting was $1.75 per ton. However, if the quantity of silage handled were increased to 500 tons per year, the cost of harvesting would have been lowered to $1.30 per ton.

The main advantages of the pickup chopper method are the small amount of man labor required per ton and the rapidity with which the job can be done. To restate these requirements: a four-man crew working a normal 7-hour day can ensile from 60 up to 80 or 85 tons of silage with a field chopper and complementary equipment. To store the same quantity of silage a three-man crew using the loader-ensilage cutter method would require from 4 to 5 days.

The main disadvantage of this method is the heavy investment in machinery and equipment. As the pickup chopper has not been used much in chopping hay in the surveyed area, the farmer still has the additional investment in loader, buckrake, baler, or other equipment used in making hay. Loading and unloading by hand or loading with hayloaders and unloading by hand is extremely heavy work. Hired hands naturally prefer the easier methods.

APPENDIX

A few of the tables assembled in this appendix pertain to haymaking on a United States basis, but most of them contain data obtained in the survey of the sample farms. These data have been used directly in preparing the text and the summary tables in the text. Anyone who is interested in greater detail, or in itemized statements of machine costs for numerous pieces of haymaking equipment, will find these tables useful. They contain tabular statements and comparisons that are not readily available elsewhere.

Procedures in computing costs

In computing costs of harvesting hay, three principal items were considered—labor, power, and machinery.

Labor costs are the average inputs of man-hours multiplied by hourly wage rates, both ascertained from farmers in this study. The labor inputs are shown in the tables listed in the discussion of the different methods of harvest, and the wage rates are shown in table 45.

Power costs are the tractor, truck, and workstock inputs contained in the tables for the different methods multiplied by the hourly cost rates shown in table 45.

Machine costs were computed for each of the machines used in making hay. In each machine cost are charges for depreciation, repairs and services, housing, interest, and taxes. An explanation of how each of these charges was ascertained is found in the following paragraphs.

(1) *Cost of machine when purchased.*—This item is used in the calculation of depreciation. Farmers reported the cost to them when purchased new of each implement they used when making hay in 1945. Each of the sample areas has its own weighted-average cost, obtained by dividing the total dollars spent for a particular machine by the total number of machines for which the purchase price was given.

(2) *Estimated life of machine.*—This item is used in the calculation of depreciation. Farmers estimated the number of years of service they expected out of each individual machine purchased new. A weighted average of these estimates was obtained for each area by totaling the individual estimates and dividing that total by the number of machines for which the life was estimated.

(3) *Depreciation.*—Simple, straight-line depreciation was assumed. To get this annual depreciation charge, the average cost when purchased was divided by the average years of estimated life.

(4) *Interest and taxes.*—A constant rate of interest was figured for all areas. This rate was 5 percent of one-half of pur-

chase price. Taxes were reported by farmers in many cases; where not reported they were calculated as one-half of 1 percent of purchase price of each machine.

(5) *Housing.*—This is an estimated figure based on available data from studies by various States and adjusted and adapted to apply to the areas in this study.

(6) *Repairs and services.*

(a) *Cash expenditures.*—Actual cash expenditures for repair parts and labor bills were reported for each machine by the farmers. No farm labor used for repairing is included in this figure. The total of cash expenditures thus reported was divided by the total number of machines to get the average cash expenditure per machine.

(b) *Farm labor.*—Farmers reported the number of hours of farm labor spent in making repairs on each individual machine. The average number of hours per machine was determined. The farm labor was valued according to the labor schedule given in table 45.

(c) *Lubricating oil, grease, etc.*—This figure is based on scattered reports of farmers in this survey and on data in miscellaneous publications. The charge for this item varies directly with the use of the machine.

(7) *Total annual machine cost.*—The sum of the preceding items of cost makes up the total annual machine cost which represents the dollars-and-cents cost to the farmer for operating the machine in 1945.

(8) *Machine cost per acre.*—In figuring the per acre cost, allowance was made for all acres, both hay and other than hay, on which the machine was used. The average annual machine cost was divided by the average number of acres of such use to get the machine cost per acre.

(9) *Machine cost per ton.*—The machine cost per acre was divided by the yield per acre per cutting on the farms reporting the use of the machine in question to get the machine cost per ton of hay.

TABLE 35.—*Land use on sample farms, 1945*

State and area[1]	Size of hay enterprise[2]	Farms in sample	Average per farm									
			Total operated	Hay[3]	Corn	Small grain	Truck and fruit	Specified crops		Other crops	Pasture[4]	Other land[5]
								Kind	Amount			
		Number	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*		*Acres*	*Acres*	*Acres*	*Acres*
New York:												
Eastern	Small	16	148	34	12	7	(6)			2	65	28
	Medium	30	249	55	24	14	(6)			4	108	44
	Large	18	377	93	30	26	1			6	131	90
	All farms	64	260	60	22	16	(6)			4	104	54
Central	Small	28	138	27	7	10	4			3	63	24
	Medium	36	230	46	14	16	4			4	107	39
	Large	33	374	76	24	29	10			6	163	66
	All farms	97	252	51	16	19	6			4	113	43
Western	Small	90	178	26	9	35	8			16	44	40
	Medium	95	260	46	18	53	8			16	74	45
	Large	66	446	83	31	80	23			27	138	64
	All farms	251	280	49	18	53	12			19	80	49
Pennsylvania:												
South central	Small	42	123	22	26	36	3			2	21	13
	Medium	35	180	41	40	48	3			2	28	18
	Large	23	319	74	68	72	3			5	59	38
	All farms	100	188	41	41	49	3			3	32	19
Northwestern	Small	35	156	23	11	21	3			5	52	41
	Medium	47	190	36	18	27	3			2	67	37
	Large	22	427	83	37	73	6			16	130	82
	All farms	104	229	41	20	35	4			6	76	47

TABLE 35.—*Land use on sample farms, 1945—Continued*

State and area[1]	Size of hay enterprise[2]	Farms in sample	Average per farm									
			Total operated	Hay[3]	Corn	Small grain	Truck and fruit	Specified crops		Other crops	Pasture[4]	Other land[5]
								Kind	Amount			
		Number	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*		*Acres*	*Acres*	*Acres*	*Acres*
Wisconsin	Small	18	76	15	13	16	5			1	22	4
	Medium	22	106	22	21	25	5			1	22	10
	Large	35	198	43	40	41	5			1	43	25
	All farms	75	142	30	28	30	5			1	31	17
Minnesota	Small	18	180	16	34	26	(7)			10	18	76
	Medium	21	185	23	44	42	(7)			7	35	34
	Large	33	324	44	79	64	(7)			12	59	66
	All farms	72	247	31	57	48	(7)			10	42	59
North Dakota	Small	10	981	190	10	350	(7)			13	386	32
	Medium	10	1,990	510	10	115	(7)			13	1,303	39
	Large	8	4,324	1,037	2	67	(7)				3,218	
	All farms	28	2,297	546	8	185	(7)			10	1,523	26
Nebraska	Small	14	244	18	82	50	(7)			6	48	40
	Medium	16	295	37	108	50	(7)			3	60	37
	Large	17	370	61	120	72	(7)			2	70	45
	All farms	47	307	40	105	58	(7)			3	60	41
Virginia	Small	19	139	17	15	14	(7)			3	59	31
	Medium	20	204	33	21	23	(7)			3	97	27
	Large	19	445	82	44	51	(7)			4	198	66
	All farms	58	262	44	27	29	(7)			3	118	41
Tennessee	Small	26	105	24	13	5	(7)	Cotton	4	3	43	13
	Medium	28	174	55	23	14	(7)	....do	6	3	60	13
	Large	22	541	107	67	45	(7)	....do	22	3	211	86
	All farms	76	257	58	34	20	(7)	Cotton	10	3	97	35

South Carolina	Small	63	135	6	12	10	1	Cotton	8	2	12	84
	Medium	57	207	14	16	24	1	do	13	2	16	121
	Large	59	458	53	35	63	1	do	31	10	58	207
	All farms	179	264	24	21	32	1	Cotton	17	5	28	136
Arkansas	Small	33	74	6	11	2	[6]	Cotton	26	6	5	18
	Medium	32	218	27	32	4	1	do	69	35	11	39
	Large	31	841	100	137	18	17	do	277	76	70	146
	All farms	96	370	44	59	8	6	Cotton	121	38	28	66
Utah	Small	[8]21	130	24	2	23	4	Sugar beets	4	3	50	20
	Medium	20	235	49	3	70	1	do	7	3	70	32
	Large	28	470	113	8	109	5	do	16	3	126	90
	All farms	[8]69	304	68	5	73	4	Sugar beets	10	3	88	53
Washington: Central irrigated	Small	28	111	31	2	15	14			5	30	14
	Medium	37	136	48	5	17	16			4	38	8
	Large	42	337	110	11	41	17			8	130	20
	All farms	107	208	65	7	26	16			6	72	16
North coast	Small	41	62	23	[6]	5	3			1	18	12
	Medium	43	91	29	1	9	5			6	25	16
	Large	27	277	74	1	32	17			9	64	80
	All farms	111	126	38	1	13	7			5	32	32
California	Small	37	139	27	2	19	5	Cotton	14	5	20	47
	Medium	32	347	74	8	19	11	do	53	28	37	117
	Large	29	1,292	364	11	137	11	do	106	121	156	386
	All farms	98	548	142	7	54	7	Cotton	54	48	66	170

[1] See footnote 1, table 2.

[2] See table 2 for definition of small, medium, and large farms for each area.

[3] Includes acreage of hay crops cut only for seed.

[4] Includes permanent pasture, rotation pasture, and woodland grazed.

[5] Includes fallow land, crop failure, woodland not pastured, and land otherwise not used for crop production.

[6] Less than one-half acre.

[7] Included in "other crops."

[8] Two of these farms, having 1,330 and 2,820 acres respectively, are not included in any of the averages.

TABLE 36.—*Livestock on sample farms, 1945*

State and area[1]	Size of hay enterprise[2]	Farms in sample	Average per farm						
			Horses and mules	Milk cows	All other cattle	Sheep	Hogs	Chickens	Other poultry
		Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
New York: Eastern	Small	16	1	15	9	2	1	285	.....
	Medium	30	2	24	17	12	5	473	1
	Large	18	2	38	31	.....	6	433	89
	All farms	64	2	26	19	6	4	415	25
Central	Small	28	2	20	11	.....	1	295	.....
	Medium	36	3	36	20	.....	3	395	21
	Large	33	3	51	26	3	4	331	62
	All farms	97	3	36	19	1	3	344	29
Western	Small	90	2	11	10	23	3	[3]334	[4]556
	Medium	95	3	22	19	32	6	313	4
	Large	66	4	33	34	80	7	241	10
	All farms	251	3	21	20	41	5	[3]302	[4]209
Pennsylvania: South central	Small	42	1	11	8	1	10	490	43
	Medium	35	2	20	22	3	28	1,086	27
	Large	23	2	41	40	2	42	873	[5]1,211
	All farms	100	2	20	20	2	24	787	[5]306
Northwestern	Small	35	1	14	12	1	8	390	7
	Medium	47	[6]7	19	17	3	9	250	1
	Large	22	4	35	59	1	48	217	.....
	All farms	104	[6]4	20	24	2	17	290	3

Wisconsin	Small	18	2	14	7	.....	7	109	(7)
	Medium	22	2	19	10	.....	21	234	(7)
	Large	35	4	30	22	.....	34	242	(7)
	All farms	75	3	23	15	.....	24	208	(7)
Minnesota	Small	18	2	12	7	1	9	146	.....
	Medium	21	2	13	14	6	16	99	.....
	Large	33	4	22	26	6	30	161	53
	All farms	72	3	17	18	5	21	139	24
North Dakota	Small	10	3	7	43	69	23	112	(7)
	Medium	10	4	8	201	.....	21	124	(7)
	Large	8	18	8	483	195	3	57	(7)
	All farms	28	8	8	225	80	16	100	(7)
Nebraska	Small	14	4	6	21	.....	39	188	(7)
	Medium	6	[8]6	[8]10	[8]49	[8]6	[8]85	154	(7)
	Large	17	3	11	143	8	142	132	(7)
	All farms	47	[8]4	[8]9	[8]76	[8]5	[8]92	158	(7)
Virginia	Small	19	3	6	15	.....	18	150	74
	Medium	20	4	16	20	5	27	176	135
	Large	19	7	43	54	2	23	191	2
	All farms	58	4	23	28	2	23	174	72
Tennessee	Small	26	4	8	4	8	17	95	(7)
	Medium	28	4	13	11	11	28	105	(7)
	Large	22	12	44	32	39	51	148	(7)
	All farms	76	6	20	15	18	31	114	(7)
South Carolina	Small	63	2	2	2	.....	5	61	35
	Medium	57	2	4	5	.....	6	76	1
	Large	59	4	15	17	.....	17	111	.....
	All farms	179	3	7	8	.....	9	82	13

TABLE 36.—*Livestock on sample farms, 1945—Continued*

State and area[1]	Size of hay enterprise[2]	Farms in sample	Average per farm						
			Horses and mules	Milk cows	All other cattle	Sheep	Hogs	Chickens	Other poultry
		Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Arkansas	Small	33	3	1	.....	.....	10	42	[7]
	Medium	32	6	2	2	.....	20	68	[7]
	Large	31	20	10	45	.....	109	218	[7]
	All farms	96	10	4	16	.....	45	108	[7]
Utah	Small	21	2	7	16	4	2	59	143
	Medium	20	3	15	34	.....	2	94	200
	Large	28	5	22	48	146	12	9	411
	All farms	69	4	16	34	61	6	81	268
Washington: Central irrigated	Small	28	3	6	12	.....	2	51	22
	Medium	37	3	8	22	4	2	46	13
	Large	42	7	10	80	34	10	52	.....
	All farms	107	4	8	42	15	5	49	10
North coast	Small	41	1	16	10	.....	1	329	[7]
	Medium	43	1	22	13	.....	3	332	[7]
	Large	27	4	32	56	25	12	136	[7]
	All farms	111	2	22	22	6	4	283	[7]
California	Small	37	2	29	16	.....	7	74	[7]
	Medium	32	3	19	37	22	2	38	[7]
	Large	29	5	64	576	122	75	38	[7]
	All farms	98	3	36	188	43	25	50	[7]

[1] See footnote 1, table 2.

[2] See table 2 for definition of small, medium, and large farms for each area.

[3] Includes one farm which had 2,500 hens.

[4] Includes one hatchery farm which had 50,000 chicks.

[5] Includes 12,750 turkeys, and one hatchery farm which had 15,000 poults.

[6] Includes one farm which had 262 riding horses.

[7] Not listed.

[8] Includes one farm which had 40 horses, 25 beef cows, 250 feeder cattle, 280 spring pigs, and 150 feeder pigs purchased.

TABLE 37.—*Relative importance of specified hay crops ranked according to acreage cut for hay, sample farms, 1945*[1]

State and area[2]	First		Second		Third		Fourth		All other
	Kind of hay	Percentage of total hay acreage harvested	Kind of hay	Percentage of total hay acreage harvested	Kind of hay	Percentage of total hay acreage harvested	Kind of hay	Percentage of total hay acreage harvested	Percentage of total hay acreage harvested
		Percent		*Percent*		*Percent*		*Percent*	*Percent*
Pennsylvania:									
South central	Clover and timothy	34	Alfalfa	25	Clover	8	Timothy	7	26
Northwestern	Timothy	28	Clover and timothy	23	....do	16	Alfalfa and timothy	4	29
Wisconsin	Alfalfa	23	Alfalfa and timothy	15	Alfalfa and clover	12	Clover	7	43
Minnesota	....do	27	Alfalfa and clover	13	Clover and timothy	10	....do	9	41
North Dakota	Wild	99							1
Nebraska	Alfalfa	74	Clover and timothy	18	Wild	5			3
Virginia	Lespedeza	21	Timothy and lespedeza	19	Alfalfa	16	Clover and timothy	8	36
Tennessee	....do	58	Alfalfa	33	Oat	3	Soybean	2	4
South Carolina	....do	86	Cowpea	13					1
Arkansas	Alfalfa	67	Soybean	22	Lespedeza	7			4
Utah	....do	94	Wild	5					1
Washington:									
Central irrigated	Grass and legume	49	Alfalfa	47	Clover	2			2
North coast	Clover and grass	88	....do	6	Small grain	5			
California	Alfalfa	100	([3])						

[1] Acreage not duplicated in cases of two or more cuttings.
[2] See footnote 1, table 2.
[3] Oat hay was second in rank but accounted for less than one-half of one percent of total.

TABLE 38.—*Relative importance of specified hay crops ranked according to tonnage cut for hay, sample farms, 1945*

State and area[1]	First		Second		Third		Fourth		All other
	Kind of hay	Percentage of total hay tonnage harvested	Kind of hay	Percentage of total hay tonnage harvested	Kind of hay	Percentage of total hay tonnage harvested	Kind of hay	Percentage of total hay tonnage harvested	Percentage of total hay tonnage harvested
		Percent		*Percent*		*Percent*		*Percent*	*Percent*
Pennsylvania:									
South central	Alfalfa	32	Clover and timothy	29	Clover	8	Alfalfa and timothy	7	24
Northwestern	Clover and timothy	25	Timothy	24	....do	17	Alfalfa	6	28
Wisconsin	Alfalfa	29	Alfalfa and timothy	15	Alfalfa and clover	10	Clover	6	40
Minnesota	....do	34	Alfalfa and clover	14	Clover and timothy	11	....do	11	30
North Dakota	Wild	98							2
Nebraska	Alfalfa	84	Clover	12	Wild	2			2
Virginia	....do	31	Timothy and lespedeza	17	Lespedeza	14	Clover and timothy	8	30
Tennessee	....do	57	Lespedeza	37	Oat	2	Soybean	2	2
South Carolina	Lespedeza	86	Cowpea	13					1
Arkansas	Alfalfa	81	Soybean	15	Lespedeza	4			
Utah	....do	97	Wild						1
Washington:									
Central irrigated	Alfalfa	57	Grass and legume	41	Clover	1			1
North coast	Clover and grass	85	Alfalfa	7	Small grain	3			5
California	Alfalfa	100	(2)						

[1] See footnote 1, table 2.

[2] Oat hay was second but accounted for less than one-half of one percent.

TABLE 39.—*Percentage of hay cut at specified stages of maturity, sample farms, 1945*[1]

State and area[2]	Kind of hay	Percentage of hay cut when crop was in			
		25 percent bloom and under	26–55 percent bloom	56–85 percent bloom	86 percent bloom and over
		Percent	*Percent*	*Percent*	*Percent*
Wisconsin	Alfalfa	14	17	36	33
	Clover-grass mixtures	15	24	24	37
	Alfalfa-grass mixtures	15	24	24	37
Minnesota	Alfalfa	18	43	21	18
	Clover-grass mixtures	19	48	16	17
	Alfalfa-grass mixtures	19	48	16	17
Nebraska	Alfalfa	19	27	15	39
Virginia	Alfalfa	64	21	7	8
	Lespedeza	27	10	5	58
	Lespedeza-timothy mixtures	27	10	5	58
Tennessee	Alfalfa	30	33	17	20
	Lespedeza	30	15	21	34
South Carolina	Cowpea	20	1	21	58
	Lespedeza	39	43	7	11
Arkansas	Alfalfa	50	18	3	29
	Soybean	20	23	37	20
Utah	Alfalfa	54	27	5	14
Washington:					
Central irrigated	Alfalfa	46	37	7	10
	Grass-legume mixtures	35	45	11	9
North coast	Alfalfa	59	35	.....	6
	Grass-clover mixtures	25	29	11	35
California	Alfalfa	95	4	1	.....

[1] Maturity of alfalfa, clover, lespedeza, and mixed hay was determined by bloom stages. Maturity of cowpea hay was determined by pod-development stages such as: (1) Pods beginning to form, (2) pods half filled, (3) pods full, (4) pods ripe. These four stages are assumed to be comparable to the bloom stages which head the columns of this table. Comparable stages in the maturity of soybean hay are: (1) Late bloom, (2) pods beginning to form, (3) pods half filled, (4) pods fully formed and filled.

[2] See footnote 1, table 2.

TABLE 40.—*Time elapsed between mowing and raking, sample farms, 1945*

State and area[1]	Kind of hay and cutting	Percentage of fields raked					Average time elapsed
		Less than 12 hours after mowing	12–35 hours after mowing	36–60 hours after mowing	61–84 hours after mowing	85 hours or more after mowing	
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Hours*
Wisconsin	Alfalfa:						
	First cutting	6	26	42	23	3	45
	Second cutting	5	40	47	8	.....	40
	Grass-legume mixtures	8	35	45	10	2	39
Minnesota	Alfalfa:						
	First cutting	11	54	27	5	3	33
	Second cutting	9	76	12	3	.....	26
	Grass-legume mixtures:						
	First cutting	8	39	31	8	14	50
	Second cutting	9	69	19	3	.....	27
North Dakota	Wild	38	54	8	.....	.....	18
Nebraska	Alfalfa:						
	First cutting	17	60	21	.....	2	29
	Second cutting	28	52	16	2	2	25
	Third cutting	28	62	10	.....	.....	20
Virginia	Alfalfa:						
	First cutting	6	75	13	6	.....	30
	Second cutting	6	94	.....	.....	.....	25
	Third cutting	7	86	.....	7	.....	26
	Fourth cutting	14	57	22	7	.....	29
Tennessee	Alfalfa:						
	First cutting	6	78	13	.....	3	28
	Second cutting	26	65	6	.....	3	24
	Third cutting	21	69	7	3	.....	22
	Fourth cutting	24	61	15	.....	.....	23
	Fifth cutting	25	62	13	.....	.....	21
	Lespedeza	26	68	6	.....	.....	22

South Carolina	Lespedeza	52	47			1	14
	Cowpea	11	26	13	23	27	57
Arkansas	Alfalfa:						
	First cutting		37	54	6	3	43
	Second cutting	4	58	38			31
	Third cutting	3	71	26			28
	Fourth cutting	2	82	16			25
	Soybean		31	53	4	12	53
	Lespedeza	7	81	7		5	33
Utah	Alfalfa:						
	First cutting	59	31	6		4	15
	Second cutting	74	19	5	2		11
	Third cutting	30	48	16		6	31
Washington:							
Central irrigated	Alfalfa:						
	First cutting	21	65	13		1	21
	Second cutting	62	33	4	1		11
	Third cutting	7	66	23	4		37
	Grass-legume mixtures:						
	First cutting	36	59	5			13
	Second cutting	34	63	3			14
North coast	Grass-legume mixtures:						
	First cutting	5	42	37	13	3	40
	Second cutting	9	27	55		9	47
California	Alfalfa:						
	First cutting	5	27	37	14	17	54
	Second cutting	19	55	20	4	2	28
	Third cutting	41	46	12		1	19
	Fourth cutting	44	45	10		1	18
	Fifth cutting	38	46	13		3	22
	Sixth cutting	12	40	32	8	8	39

[1] See footnote 1, table 2.

TABLE 41.—*Time elapsed between raking, and baling, chopping, or storing as long loose hay, sample farms, 1945*

State and area[1]	Kind of hay and cutting	Method of handling	Percentage of fields handled as specified							Average time elapsed
			Less than 12 hours after raking	12–35 hours after raking	36–60 hours after raking	61–84 hours after raking	85–108 hours after raking	109–132 hours after raking	133 hours or more after raking	
			Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Hours*
Wisconsin	Alfalfa:									
	First cutting	Stored loose	68	11	21					10
	Second cutting	do	88	12						7
	Grass-legume mixtures	do	74	19	7					10
	Alfalfa:									
	First cutting	do	35	44	13			4	4	29
	Second cutting	do	36	32	9	5	5	4	9	46
Minnesota	Alfalfa:									
	First cutting	Field chopper	57	43						13
	Second cutting	do	67	33						11
	Grass-legume mixtures:									
	First cutting	Stored loose	48	33	5	2		5		24
	Second cutting	do	53	27	13		7			19
North Dakota	Wild	do	43	36	14	7				21
	Alfalfa:									
	First cutting	do	38	48	7	7				20
	Second cutting	do	37	58					5	21
Nebraska	Third cutting	do	39	61						16
	Alfalfa:									
	First cutting	Pickup baler	6	47	29	12		6		41
	Second cutting	do	22	61	13	4				26
	Third cutting	do	17	67	11	5				27

	Alfalfa:									
	First cutting	Stored loose	60	33	7					11
Virginia	Second cutting	do	60	33	7					10
	Third cutting	do	73	18	9					10
	Fourth cutting	do	67	22	11					10
	Lespedeza	do	43	29	14				14	56
	Alfalfa:									
	First cutting	do	67	25	4			4		12
	Second cutting	do	85	15						5
	Third cutting	do	83	17						5
	Fourth cutting	do	75	25						6
	Fifth cutting	do	83	17						1
Tennessee	Alfalfa:									
	First cutting	Baled	38	25	13	24				32
	Second cutting	do	10	70	10	10				28
	Third cutting	do	11	78	11					24
	Fourth cutting	do		100						21
	Lespedeza	Stored loose	78	17		5				8
	do	Baled	47	40	7		6			19
	Lespedeza	Stored loose	59	40	1					11
South Carolina	do	Stationary baler	12	80			4	4		28
	Cowpea	Stored loose	48	15	9	5	2	2	19	75
	Alfalfa:									
	First cutting	do	8	58	17				17	49
	Second cutting	do	8	67	8				17	33
	Third cutting	do		100						21
	Alfalfa:									
	First cutting	Pickup baler		69	31					27
Arkansas	Second cutting	do		50	40				10	48
	Third cutting	do	10	70	10				10	34
	Alfalfa:									
	First cutting	Stationary baler	25	25	25	25				34
	Second cutting	do	25		25	25	25			52
	Third cutting	do	20	60		20				30

TABLE 41.—*Time elapsed between raking, and baling, chopping, or storing as long loose hay, sample farms, 1945 —Continued*

State and area[1]	Kind of hay and cutting	Method of handling	Percentage of fields handled as specified							Average time elapsed
			Less than 12 hours after raking	12–35 hours after raking	36–60 hours after raking	61–84 hours after raking	85–108 hours after raking	109–132 hours after raking	133 hours or more after raking	
			Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Hours*
Arkansas (Cont'd)....	Soybean.....	Stored loose ..	.....	50	12	.....	.....	13	25	75
	Soybean.....	Stationary baler	8	50	34	.....	8..	.....	.....	35
	Alfalfa:									
	First cutting.....	Stored loose ..	.....	9	24	15	21	4	27	93
	Second cutting.....	....do.....	.....	9	20	11	20	11	29	98
Utah.....	Third cutting.....	....do.....	.....	4	10	20	13	10	43	126
	Alfalfa:									
	First cutting.....	Baled.....	.....	10	16	21	16	16	21	93
	Second cutting.....	....do.....	.....	13	20	34	13	13	7	75
	Third cutting.....	....do.....	.....	10	10	20	10	20	30	103
Washington:										
	Alfalfa:									
	First cutting.....	Stored loose ..	2	18	16	13	13	18	20	87
	Second cutting.....	....do.....	5	27	9	20	17	10	12	75
	Third cutting.....	....do.....	.....	11	11	11	13	18	34	117
	Alfalfa:									
	First cutting.....	Baled.....	25	25	25	25	.....	.....	.....	51
Central irrigated .	Second cutting.....	....do.....	24	13	37	13	.....	13	.....	45
	Grass-legume mixtures									
	First cutting.....	Stored loose ..	3	51	28	9	6	3	.....	39
	Second cutting.....	....do.....	.....	50	30	4	8	8	.....	40
	Grass-legume mixtures:									
	First cutting.....	Baled.....	.....	66	17	17	.....	.....	.....	35
	Second cutting.....	....do.....	.....	50	25	25	.....	.....	.....	33

North coast	Grass-legume mixtures:									
	First cutting	Stored loose	7	39	17	9	2	5	21	74
	Second cutting	do		45	44		11			42
	Grass-legume mixtures	Baled	27	55	18					23
California	Alfalfa:									
	First cutting	Stored loose		14	24	5	33	5	19	92
	Second cutting	do		19	29	33	5	9	5	69
	Third cutting	do		24	43	28	5			50
	Fourth cutting	do		26	37	32	5			50
	Fifth cutting	do		20	45	20	15			54
	Sixth cutting	do		25	34	17	8	8	8	62
	Alfalfa:									
	First cutting	Pickup baler		6	6		22	33	33	123
	Second cutting	do		5	17	39	11	17	11	84
	Third cutting	do		11	28	50	6		5	66
	Fourth cutting	do		11	39	44			6	62
	Fifth cutting	do		6	19	56	19			69
	Sixth cutting	do			9	9	27	19	36	123
	Alfalfa:									
	First cutting	Shock baler					50	50		108
	Second cutting	do					100			96
	Third cutting	do				100				72
	Fourth cutting	do				100				72
	Fifth cutting	do				50		50		96
	Alfalfa:									
	First cutting	Stationary chopper							100	204
	Second cutting	do						67	33	140
	Third cutting	do				17	17	33	33	124
	Fourth cutting	do				17	17	33	33	124
	Fifth cutting	do					40	20	40	154
	Alfalfa:									
	First cutting	Field pickup chopper		6	6		6	18	64	160
	Second cutting	do		11	6	12	35	18	18	97
	Third cutting	do		6	24	29	29	6	6	80
	Fourth cutting	do		6	29	24	29	6	6	78
	Fifth cutting	do		6	12	19	31	13	19	104
	Sixth cutting	do			16	17	17		50	114

See footnote 1, table 2.

TABLE 42.—*Haying machinery and equipment sold for use in the United States, 1935–49*[1]

Type of equipment	1935	1936	1937	1938	1939	1940	1941	1942
Mowers:	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*
Horse—or tractor-drawn (ground driven)	113.7	102.3	107.6	75.8	54.6	57.3	83.8	70.3
Tractor (mounted or semimounted)	(2)	(2)	(2)	(2)	24.7	42.7	70.8	47.2
Rakes:								
Sulky (dump)	37.6	37.3	41.1	28.2	26.0	29.7	40.0	26.5
Side delivery[3]	17.0	21.6	23.2	19.9	18.1	25.3	35.2	29.2
Buckrakes	[4]7.1	6.5	6.6	[4]5.7	[3]5.5	7.1	10.2	11.7
Hay loaders	11.1	[4]21.5	23.2	18.6	15.4	20.6	27.2	21.9
Stackers:								
Stationary	[4]1.7	[4]1.8	1.6	[4]1.3	[4]1.4	1.4	1.5	1.8
Combination (buckstacker)	(5)	(5)	(5)	(5)	(5)	(5)	(6)	1.8
Balers:								
Pickup	(6)	(6)	(6)	(6) (4)	[4].4	1.5	7.4	8.9
Stationary:								
Horse	1.2	.8	.9	[4].5	.8	.4	.4	(5)
Engine or belt	2.8	3.3	3.9	2.3	3.1	5.2	5.7	3.2
Hay carriers	[4]31.4	[4]40.2	[4]41.7	[4]39.9	[4]38.1	42.5	63.7	34.3
Hay forks[7]	[4]37.4	[4]44.5	[4]46.9	[4]40.7	[4]39.5	46.6	72.5	47.0
Hay slings	[4]42.2	43.6	40.2	25.1	21.5	22.5	29.2	49.5
	1,000 feet	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*
Track for carriers	[4]1,448.0	[4]1,576.2	1,853.7	1,681.0	[4]1,679.9	1,906.0	2,712.3	1,169.6

TABLE 42.—*Haying machinery and equipment sold for use in the United States, 1935–49*[1]*—Continued*

Type of equipment	1943	1944	1945	1946	1947	1948	1949
Mowers:	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*
Horse— or tractor-drawn (ground driven)	15.1	48.3	47.8	36.7	44.1	47.6	32.6
Tractor (mounted or semimounted)	31.5	70.8	65.9	76.2	130.6	211.4	183.7
Rakes:							
Sulky (dump)	9.6	18.7	23.0	17.8	29.7	22.5	18.2
Side delivery[3]	13.9	38.5	37.9	27.8	53.9	89.7	107.1
Buckrakes	5.1	14.4	17.5	38.1	20.5	13.9	5.4
Hay loaders	12.6	20.0	18.6	23.9	16.0	27.5	12.4
Stackers:							
Stationary	.6	1.5	2.0	([5])	([5])	([5])	([5])
Combination (buckstacker)	2.7	7.4	8.8	8.7	7.3	7.6	4.3
Balers:							
Pickup	4.2	11.8	12.3	10.8	24.8	44.3	51.0
Stationary:							
Horse	.1	([5])	.....	.....	.....	.....	.....
Engine or belt	1.4	4.4	4.6	5.6	6.2	3.4	2.3
Hay carriers	28.3	53.0	39.0	45.4	56.1	43.8	16.0
Hay forks[7]	31.1	63.6	73.4	86.3	83.8	43.7	21.1
Hay slings	39.8	51.9	48.4	59.0	39.7	37.0	25.3
	1,000 feet	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*	*1,000 feet*
Track for carriers	1,248.5	1,275.8	1,510.2	1,729.9	2,007.0	1,601.1	438.8

[1] Compiled from publications of Bureau of Census, 1935–40 from MANUFACTURE AND SALE OF FARM EQUIPMENT AND RELATED PRODUCTS; 1941–49 were taken from FACTS FOR INDUSTRY—FARM MACHINERY AND EQUIPMENT.

[2] Not given separately; included with drawn-type mowers.

[3] Including combination side rakes and tedders.

[4] Includes exports.

[5] Not given separately.

[6] Not available.

[7] Harpoon, grapple, etc. (no hand pitchforks).

TABLE 43.—*Yield per acre of hay by kind and by size of hay enterprise, sample farms, 1945*[1]

State and area[2]	Kind of hay	Average yield per acre							
		Total				Once-over basis			
		Small hay enterprises	Medium hay enterprises	Large hay enterprises	All farms	Small hay enterprises	Medium hay enterprises	Large hay enterprises	All farms
		Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
New York:									
Eastern	All hay	1.56	1.77	2.26	1.95	1.45	1.50	1.61	1.54
Central	....do	1.87	2.16	2.52	2.31	1.69	1.86	2.04	1.93
Western	....do	1.76	2.06	2.29	2.11	1.39	1.54	1.69	1.58
Pennsylvania:									
	Alfalfa	1.62	2.20	2.79	2.48	.77	.92	1.33	1.10
	Clover	1.50	1.49	1.50	1.50	1.38	1.42	1.38	1.39
South central	Timothy	1.03	1.32	1.32	1.18	1.03	1.32	1.32	1.18
	Clover and timothy	1.47	1.62	1.79	1.61	1.41	1.42	1.50	1.44
	Alfalfa and timothy	2.63	2.60	1.97	2.27	.94	1.27	1.38	1.28
	Alfalfa	1.60	3.28	3.31	3.06	1.40	1.80	2.00	1.80
	Clover	1.75	2.16	2.71	2.25	1.27	1.72	2.60	1.86
Northwestern	Timothy	1.43	1.96	1.67	1.78	1.43	1.96	1.67	1.78
	Clover and timothy	1.72	2.43	2.56	2.37	1.64	1.79	2.32	2.13
	Alfalfa and timothy	2.08	2.27	2.62	2.62	1.79	1.85	2.42	2.06
	Alfalfa	2.68	2.76	3.32	3.10	2.32	2.30	2.81	2.40
	Alfalfa and timothy	1.92	2.46	3.31	2.73	1.64	1.71	1.97	1.82
Wisconsin	Clover	1.87	1.90	3.02	2.52	1.87	1.90	2.57	2.30
	Clover and timothy	2.21	2.04	2.24	2.17	1.70	1.84	2.10	1.90
	Timothy	.....	1.94	1.90	1.92	.....	1.94	1.90	1.92
	Alfalfa	2.95	2.61	2.91	2.84	1.20	1.24	1.38	1.33
	Clover and timothy	.....	2.28	2.77	2.67	.....	1.70	1.66	1.66
Minnesota	Alfalfa and timothy	.....	.....	.....	2.10	.....	.....	.....	1.47
	Alfalfa and clover	.....	.....	.....	2.14	.....	.....	.....	.....
	Wild	.82	1.02	1.16	1.05	.82	1.02	1.16	1.05

North Dakota	Wild	.70	.92	1.10	1.00	.70	.92	1.10	1.00
Nebraska	Alfalfa	3.07	2.97	3.09	3.05	1.17	1.06	1.13	1.13
	Clover	1.15	1.82	2.15	1.82	1.15	1.82	2.15	1.82
Virginia	Alfalfa	2.63	3.02	3.24	3.19	.....	.75	.88	.86
	Lespedeza	.97	1.12	1.18	1.13	.97	1.12	1.18	1.13
	Lespedeza and timothy	1.25	1.35	1.62	1.48	.....	.....	.....	.....
	Clover and timothy	1.33	1.64	2.03	1.76	.....	.....	.....	.....
Tennessee	Alfalfa	3.00	2.69	3.12	3.01	.95	.87	.82	.85
	Lespedeza	.92	1.01	1.26	1.12	.92	1.01	1.26	1.12
	Oat	.....	.....	.....	1.10	.....	.....	.....	1.10
	Soybean	.....	.....	.....	1.28	.....	.....	.....	1.28
South Carolina	Lespedeza	.79	.97	1.04	1.01	.79	.97	1.04	1.01
	Cowpea	.78	.88	1.07	1.00	.78	.88	1.07	1.00
Arkansas	Alfalfa	2.47	2.50	2.62	2.59	.71	.68	.80	.77
	Soybean	1.58	1.60	1.66	1.64	1.58	1.60	1.66	1.64
	Lespedeza	1.24	1.33	1.24	1.24	1.24	1.23	1.25	1.24
Utah	Alfalfa	2.91	3.20	2.86	2.94	1.38	1.53	1.58	1.53
Washington:									
Central irrigated	Alfalfa	3.06	3.28	4.00	3.69	1.26	1.28	1.59	1.45
	Grass and legume	2.78	2.12	2.65	2.54	1.35	1.52	1.60	1.54
	Small grain	.....	.....	.....	1.50	.....	.....	.....	1.50
	Clover	.....	.....	.....	1.79	.....	.....	.....	1.63
	Wild	.....	.....	.....	1.33	.....	.....	.....	1.33
North coast	Alfalfa[3]	4.00	3.74	4.42	4.26	2.10	2.20	2.37	2.25
	Grass and clover[3]	2.40	2.94	2.67	2.69	2.35	2.75	2.52	2.54
	Small grain[3]	1.77	1.84	2.10	2.08	1.77	1.84	2.10	2.08
California	Alfalfa	5.33	6.10	6.37	6.25	1.13	1.33	1.21	1.23
	Oat	3.87	4.00	.....	3.50	.....	.....	.....	3.50

[1] See table 2 for definition of small, medium, and large farms for each area.

[2] See footnote 1 table 2.

[3] Includes grass silage—3 tons silage equivalent to one ton hay.

TABLE 44.—*Percentage distribution of hay harvested, by methods used and by size of hay enterprise, sample farms, 1945*

State and area[1]	Method of harvesting	Percentage of total hay harvested by size of hay enterprise			
		Small	Medium	Large	All farms
New York:		*Percent*	*Percent*	*Percent*	*Percent*
	Load and unload by hand—barn	14.6	0	0.1	1.7
	Load by hand and unload with power fork—barn	13.5	8.0	2.8	6.0
Eastern	Load with loader and unload with power fork—barn	27.0	36.0	31.2	32.5
	Buckrake to barn and store with power fork	8.0	6.1	.....	3.3
	Pickup baler	31.1	39.8	63.6	50.8
	Chopping with stationary chopper	.8	3.8	1.8	2.4
	All other	5.0	6.3	.5	3.3
	Load and unload by hand—barn	.2	.3	.2	.2
	Load by hand and unload with power fork—barn	.....	.....	.4	.3
	Load with loader and unload with power fork—barn	24.5	35.6	46.4	40.7
Central	Buckrake to barn and store with power fork	58.7	34.1	5.5	20.1
	Baling with stationary baler	2.5	1.8	1.0	1.4
	Pickup baler	14.1	22.3	46.5	35.6
	Chopping with stationary chopper	.....	5.9	.....	1.7
	Load and unload by hand—barn	13.0	3.8	1.9	4.3
	Load by hand and unload with power fork—barn	1.0	.....	.....	.2
	Load with loader and unload with power fork—barn	37.4	24.6	15.5	22.4
	Buckrake to barn and store with power fork	4.4	12.8	1.6	6.3
Western	Baling with stationary baler	2.1	.8	.7	1.0
	Pickup baler	23.8	39.5	61.1	47.1
	Chopping with stationary chopper	3.8	6.3	1.6	3.7
	Chopping with pickup chopper	.....	1.4	5.6	3.1
	All other	14.5	10.8	12.0	[2]11.9
Pennsylvania:	Load and unload by hand—barn	5.3	.3	.....	1.0
	Load by hand and unload with power fork—barn	.....	.1	.....	.....
	Load with loader and unload with power fork—barn	42.0	26.1	18.9	25.4
	Buckrake to barn and store with power fork	16.5	9.4	6.8	9.4
South central	Buckstacker	4.6	.....	.8	1.2

	Baling with stationary baler	1.2	.9	.....	.5
	Pickup baler	29.7	57.1	69.4	58.3
	Chopping with stationary chopper	.7	1.4	.6	.9
	Chopping with pickup chopper	.....	2.5	3.5	2.5
	All other	.....	2.2	.....	.8
	Load and unload by hand—barn	2.6	1.7	.....	1.0
	Load by hand and unload with power fork—barn	.4	.7	.....	.3
	Load with loader and unload with power fork—barn	26.9	29.3	4.9	17.2
	Buckrake to barn and store with power fork	37.1	13.6	6.8	13.7
	Baling with stationary baler	.....	1.0	.....	.4
Northwestern	Pickup baler	25.2	33.3	76.4	52.9
	Chopping with stationary chopper	78.0	13.6	5.5	8.8
	Chopping with pickup chopper	.....	6.6	6.4	5.6
	All other	.....	.2	.....	.1
	Load with loader and unload with power fork—barn	69.3	56.7	35.9	43.5
	Buckrake to barn and store with power fork	9.2	14.0	5.2	7.3
	Buckstacker	.....	3.4	.....	.7
Wisconsin	Baling with stationary baler	5.9	7.4	3.1	4.3
	Pickup baler	2.5	9.3	30.8	23.6
	Chopping with stationary chopper	.....	4.1	.....	.8
	Chopping with pickup chopper	13.1	5.1	24.6	19.6
	All other	.....	.....	.4	.2
	Load with loader and unload with power fork—barn	74.3	54.2	27.3	37.4
	Buckrake to barn and store with power fork	4.8	6.6	.5	2.3
Minnesota	Buckstacker	10.0	9.1	20.0	16.7
	Pickup baler	4.1	15.1	30.5	24.8
	Chopping with pickup chopper	6.6	14.9	21.5	18.6
	All other	.2	.1	.2	.2
	Buckrake to barn and store with power fork	3.8	.....	.....	.3
North Dakota	Buckrake to stacker	81.9	93.4	100.0	97.0
	Buckstacker	14.3	6.6	.....	2.7
	Load by hand and unload with power fork—barn	.....	3.5	.....	2.0
	Load with loader and unload with power fork—barn	47.8	35.1	40.1	38.7
Nebraska	Buckrake to barn and store with power fork	.....	2.0	.....	.7
	Buckstacker	.....	3.4	4.7	3.7

TABLE 44.—*Percentage distribution of hay harvested, by methods used and by size of hay enterprise, sample farms, 1945—Continued*

State and area[1]	Method of harvesting	Percentage of total hay harvested by size of hay enterprise			
		Small	Medium	Large	All farms
		Percent	*Percent*	*Percent*	*Percent*
Nebraska (Cont'd)	Pickup baler	45.3	45.8	48.2	46.8
	Chopping with pickup chopper	.....	1.5	1.2	1.2
	All other	6.9	8.7	5.8	6.9
Virginia	Load and unload by hand—barn	3.4	2.9	.4	1.2
	Load by hand and unload with power fork—barn	38.1	32.3	5.7	14.9
	Load with loader and unload by hand—barn	.7	.2	.2	.3
	Load with loader and unload with power fork—barn	17.1	27.8	49.8	41.7
	Load and unload by hand—stack	26.0	17.5	2.2	8.0
	Baling with stationary baler	1.5	.7	.....	.4
	Pickup baler	11.7	12.8	32.4	25.8
	All other	1.5	5.8	9.3	7.7
Tennessee	Load and unload by hand—barn	15.4	.....	.....	1.1
	Load by hand and unload with power fork—barn	43.7	49.6	14.3	24.8
	Load with loader and unload with power fork—barn	.....	2.6	.....	.6
	Buckrake to barn and store with power fork	3.1	.....	2.9	2.2
	Load and unload by hand—stack	14.8	11.1	3.2	5.9
	Baling with stationary baler	9.6	5.1	26.8	20.4
	Pickup baler	13.4	31.6	52.8	45.0
South Carolina	Load and unload by hand—barn	94.0	88.0	42.0	54.0
	Load by hand and unload with power fork—barn	3.0	3.0	19.0	15.0
	Baling with stationary baler	3.0	9.0	39.0	31.0
Arkansas	Load and unload by hand—barn	56.4	.5	.....	1.9
	Load by hand and unload with power fork—barn	6.7	6.8	3.8	4.5
	Load with loader and unload with power fork—barn	.....	6.0	.....	1.1
	Baling with stationary baler	20.2	14.4	7.9	9.5
	Pickup baler	16.7	28.3	61.3	53.7
	All other	.....	44.0	27.0	[3]29.3

Utah	Load and unload by hand—barn	.....	2.4	1.6	1.6
	Load by hand and unload with power fork—barn	4.8	.....	.....	.5
	Load with loader and unload with power fork—barn	5.2	2.9	.....	1.2
	Load and unload by hand—stack	5.7	.....	.....	.6
	Buckstacker	.....	.....	17.6	11.9
	Pickup baler	14.1	26.4	57.7	46.2
	Chopping with pickup chopper	6.8	14.4	2.1	5.4
	All other	63.4	53.9	21.0	[4]32.6
Washington:					
Central irrigated	Buckrake to stacker	57.8	57.4	44.7	47.8
	Baling with stationary baler	.....	3.4	9.9	8.3
	Pickup baler	3.5	16.1	25.4	21.8
	Chopping with stationary chopper	.....	1.4	1.2	1.1
	Chopping with pickup chopper	.....	.9	3.5	2.3
	All other	38.7	20.8	15.3	[5]18.7
North coast	Load and unload by hand—barn	10.2	6.5	1.9	4.8
	Load by hand and unload with power fork—barn	26.4	16.1	6.7	13.0
	Load with loader and unload by hand—barn	13.3	11.6	5.5	8.8
	Load with loader and unload with power fork—barn	18.9	23.9	11.8	16.9
	Buckrake to barn and store with power fork	3.6	6.0	.5	2.9
	Buckrake to stacker	2.7	.....	.....	.4
	Baling with stationary baler	.....	2.7	.9	1.3
	Pickup baler	7.1	12.9	57.0	34.4
	Chopping with pickup chopper	.....	1.6	1.2	1.1
	All other	17.8	18.7	14.5	[6]16.4
California	Load and unload by hand—barn	.7	1.2	.....	.2
	Load by hand and unload with power fork—barn	1.9	.....	.....	.1
	Load and unload by hand—stack	10.4	.....	.....	.6
	Baling with stationary baler	12.6	.....	2.6	2.7
	Pickup baler	34.5	67.7	49.7	51.7
	Chopping with stationary chopper	7.1	4.5	25.0	20.7
	Chopping with pickup chopper	8.3	23.6	20.3	20.1
	All other	24.5	3.0	2.4	3.9

[1] See footnote 1, table 2.

[2] Includes these methods: Load with loader and blow long hay into barn, 1.6 percent; hauling with buckrake and pitched by hand into barn, 4.6 percent; hauling with buckrake and blow long hay into barn, 5.7 percent.

[3] Dehydrated for meal.

[4] Includes these methods: Load by hand and roll off—stack, 13.8 percent; load with loader and roll off—stack, 0.3 percent; load by hand and unload with derrick—stack, 12.8 percent; load with loader and unload with derrick—stack, 5.7 percent.

[5] Includes these methods: Load by hand and unload with derrick—stack, 17.1 percent; miscellaneous, 1.6 percent.

[6] Includes these methods: Haul with buckrakes and pitch by hand into barn, 2.9 percent; hay crops ensiled, 13.5 percent. (Three tons of silage equivalent to one ton of hay.)

TABLE 45.—*Rates per hour used in calculating the cost of harvesting hay, sample farms, 1945*[1]

State and area[2]	Man labor	Tractor work	Truck	Workstock
New York:				
Eastern	$0.55	$0.60	$0.60	$0.35
Central	.55	.60	.60	.35
Western	.55	.60	.60	.35
Pennsylvania:				
South central	.55	.60	.60	.35
Northwestern	.55	.60	.60	.35
Wisconsin	.55	.60	.55	.29
Minnesota	.60	.60	.55	.25
North Dakota	.70	.60	.55	.24
Nebraska	.65	.60	.55	.25
Virginia	.40	.60	.55	.27
Tennessee	.30	.55	.50	.24
South Carolina	.25	.55	.50	.27
Arkansas	.30	.55	.50	.24
Utah	.80	.60	.55	.24
Washington:				
Central irrigated	1.00	.60	.55	.25
North coast	1.00	.60	.55	.25
California	.85	.60	.55	.22

[1] Based on estimates by operators of sample farms in 1945 and on unpublished studies of the Bureau of Agricultural Economics.

[2] See footnote 1, table 2.

TABLE 46.—*Estimated annual machine cost of horse-drawn mowers, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per acre	Per ton
						Cash	Farm labor	Lubricating oil, grease etc.			
		Years									
New York:											
Eastern	$ 98	22	$4.45	$2.95	$1.60	$6.62	$3.08	$0.22	$18.92	$0.43	$ 0.28
Central	81	17	4.76	2.43	1.60	5.44	3.47	.21	17.91	.46	.23
Western	96	19	5.05	2.88	1.60	6.35	3.74	.28	19.90	.35	.21
Pennsylvania:											
South central	72	21	3.43	2.21	1.60	4.80	3.24	.21	15.49	.37	.26
Northwestern	86	19	4.53	2.63	1.60	5.15	3.52	.21	17.64	.43	.23
Wisconsin	74	24	3.08	2.22	1.55	2.98	1.54	.17	11.54	.35	.15
Minnesota	75	20	3.75	2.19	1.55	4.13	1.86	.22	13.70	.31	.21
North Dakota	95	17	5.58	2.82	1.50	5.00	6.79	.93	22.62	.12	.11
Nebraska	95	21	4.52	2.84	1.55	6.26	4.75	.55	20.47	.19	.16
Virginia	90	17	5.29	2.70	1.35	7.86	1.96	.47	19.63	.21	.21
Tennessee	105	20	5.25	3.14	1.00	8.59	2.97	.38	21.33	.28	.26
South Carolina	98	23	4.26	2.94	.80	5.12	1.45	.16	14.73	.44	.45
Arkansas	101	15	6.73	3.02	.80	5.38	1.50	.27	17.70	.33	.47
Utah	113	15	7.53	3.39	1.25	8.76	10.88	.51	32.32	.32	.20
Washington:											
Central irrigated	120	16	6.31	4.20	1.25	13.74	9.90	.28	35.68	.63	.47
North coast	94	24	4.92	3.32	1.60	4.96	5.60	.20	20.60	.51	.18
California	119	13	9.15	3.85	1.25	10.20	11.94	.56	36.95	.32	.28
Average[2]	95	19	5.21	2.92	1.39	6.62	4.14	.32	20.60	.37	.27

[1] See footnote 1, table 2.

[2] Average based on 873 horse-drawn mowers.

TABLE 47.—*Estimated annual machine cost of tractor mowers, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per acre	Per ton
						Cash	Farm labor	Lubricating oil, grease etc.			
		Years									
New York:											
Eastern	$134	13	$10.30	$4.03	$1.10	$7.14	$3.89	$0.45	$26.91	$0.30	$0.21
Central	139	11	12.64	4.18	1.10	5.52	3.19	.35	26.98	.41	.21
Western	144	12	12.00	4.32	1.10	9.20	3.85	.45	30.92	.34	.20
Pennsylvania:											
South central	138	13	10.61	4.11	1.10	6.18	5.36	.58	27.94	.24	.17
Northwestern	146	12	12.16	4.39	1.10	6.16	4.45	.58	28.84	.25	.13
Wisconsin	150	18	8.33	4.50	1.00	2.00	2.70	.40	18.93	.24	.12
Minnesota	145	16	9.06	4.45	1.00	2.68	2.55	.34	20.08	.30	.23
North Dakota	148	12	12.33	4.44	.95	2.66	21.00	2.90	44.28	.08	.08
Nebraska	141	13	10.85	4.29	1.00	7.65	5.52	.76	30.07	.20	.17
Virginia	135	10	13.50	4.05	.90	14.94	3.72	1.15	38.26	.17	.18
Tennessee	141	9	15.66	4.23	.70	9.86	2.85	.85	34.15	.22	.26
South Carolina	126	17	7.41	3.78	.55	7.39	2.17	.58	21.88	.18	.19
Arkansas	148	8	18.50	4.44	.55	17.00	3.30	.95	44.74	.23	.28
Utah	168	11	15.30	5.05	.85	16.50	16.00	.90	54.60	.29	.20
Washington:											
Central irrigated	174	12	14.50	5.22	.85	15.96	14.40	.80	51.73	.32	.19
North Coast	148	14	10.57	4.44	1.10	6.31	10.00	.45	32.87	.36	.13
California	181	6	30.33	5.42	.85	44.51	39.23	3.17	123.51	.20	.16
Average[2]	148	12	13.27	4.46	.94	13.77	10.94	1.04	44.42	.25	.18

[1] See footnote 1, table 2.

[2] Average based on 822 tractor mowers.

TABLE 48.—*Estimated annual machine cost of horse-drawn and tractor-drawn side-delivery rakes, sample farms, 1945*

HORSE-DRAWN

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per acre	Per ton
						Cash	Farm labor	Lubricating oil, grease etc.			
		Years									
New York:											
Eastern	$130	20	$6.50	$3.90	$2.60	$4.20	$1.27	$0.14	$18.61	$0.27	$0.16
Central	128	20	6.40	3.84	2.60	2.90	1.37	.13	17.24	.27	.17
Western	128	20	6.50	3.83	2.60	5.00	1.92	.17	20.02	.23	.15
Pennsylvania:											
South central	116	20	5.80	3.48	2.60	2.73	1.41	.14	16.16	.23	.15
Northwestern	125	20	6.25	3.80	2.60	4.12	.96	.13	17.86	.27	.14
Wisconsin	114	24	4.33	3.42	2.50	1.20	.11	.07	11.63	.32	.13
Minnesota	102	19	5.37	3.06	2.50	1.74	.60	.11	13.38	.25	.18
Nebraska	113	18	6.27	3.39	2.50	4.82	.82	.20	18.00	.18	.17
Virginia	141	14	10.07	4.22	2.20	8.13	1.49	.28	26.39	.19	.17
Tennessee	146	12	12.17	4.38	1.55	16.81	.79	.41	36.11	.18	.18
South Carolina	158	18	8.78	4.74	1.30	1.10	.12	.07	16.11	.46	.43
Arkansas	132	14	9.42	3.99	1.30	7.78	.09	.24	22.82	.20	.23
Utah	153	15	10.20	4.58	1.95	5.70	1.80	.36	24.59	.15	.10
Washington:											
Central irrigated	192	15	13.71	5.76	1.95	5.57	2.57	.35	29.91	.17	.10
North coast	138	19	7.26	4.14	2.60	3.25	1.83	.14	19.22	.27	.09
California[2]	191	11	17.36	5.73	1.95	6.00	4.80	.65	36.49	.11	.10
Average[3]	138	16	8.60	4.15	2.20	4.92	1.17	.19	21.23	.23	.16

TABLE 48.—*Estimated annual machine cost of horse-drawn and tractor-drawn side-delivery rakes, sample farms, 1945—Continued*

TRACTOR-DRAWN

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services: Cash	Repairs and services: Farm labor	Repairs and services: Lubricating oil, grease etc.	Total	Per acre	Per ton
		Years									
New York:											
Eastern	$140	18	$7.50	$4.25	$2.60	$5.00	$1.10	$0.24	$20.69	$0.17	$0.11
Central	140	18	7.50	4.25	2.60	3.60	1.21	.22	19.38	.18	.12
Western	142	18	7.88	4.26	2.60	7.25	1.65	.26	23.90	.18	.12
Pennsylvania:											
South central	137	18	7.61	4.11	2.60	4.62	1.32	.27	20.53	.18	.12
Northwestern	140	17	8.24	4.25	2.60	3.54	1.10	.17	19.90	.23	.12
Wisconsin	108	23	4.69	3.34	2.50	2.44	1.27	.08	14.32	.33	.13
Minnesota	137	18	7.61	4.11	2.50	2.90	1.05	.08	18.25	.46	.31
Nebraska	125	16	7.81	3.74	2.50	2.11	.76	.22	17.14	.15	.13
Virginia	155	11	14.09	4.66	2.20	6.50	2.50	.50	30.45	.12	.11
Tennessee	152	12	12.66	4.56	1.55	13.33	1.00	.42	33.52	.16	.16
South Carolina	176	15	11.73	5.28	1.30	5.20	.55	.14	24.20	.26	.25
Arkansas	160	12	13.33	4.80	1.30	9.46	.15	.37	29.41	.16	.17
Utah	187	12	15.58	5.62	1.95	8.60	3.50	.42	35.67	.17	.12
Washington:											
Central irrigated	200	11	18.18	6.00	1.95	8.78	2.96	.38	38.25	.20	.13
North coast	150	16	9.37	4.50	2.60	5.50	2.97	.14	25.08	.36	.12
California[2]	215	6	35.83	6.40	1.95	42.22	16.14	1.46	104.00	.14	.13
Average[3]	154	15	11.74	4.63	2.20	9.43	2.93	.37	31.30	.19	.13

[1] See footnote 1, table 2.

[2] Does not include four heavy-duty rakes bought in 1945 for an average of about $1,000 each. These rakes were used on an average of 2,045 acres each in 1945.

[3] Average based on 556 tractor-drawn side-delivery rakes.

TABLE 49.—*Estimated annual machine cost of dump rakes, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services: Cash	Repairs and services: Farm labor	Repairs and services: Lubricating oil, grease etc.	Total	Per acre	Per ton
		Years									
New York:											
Eastern	$ 52	25	$2.40	$1.76	$1.50	$0.78	$0.44	$0.08	$6.96	$0.17	$0.11
Central	32	25	2.20	1.54	1.50	.60	.28	.04	6.16	.28	.15
Western	45	25	2.04	1.50	1.50	.52	.11	.07	5.74	.16	.10
Pennsylvania:											
South central	42	24	2.00	1.41	1.50	1.00	.11	.03	6.05	.36	25
Northwestern	40	24	1.92	1.35	1.50	.20	.22	.07	5.26	.16	.08
Minnesota	58	23	2.52	2.24	1.45	.10	.12	.04	6.47	.36	.26
North Dakota	37	20	2.15	1.26	1.40	.50	.70	.61	6.62	.02	.02
Nebraska	28	25	1.21	.99	1.45	.25	.32	.09	4.31	.09	08
Virginia	31	25	1.24	.92	1.30	1.09	.80	.09	5.44	.12	.11
Tennessee	47	25	2.04	1.52	.75	.46	.27	.11	5.15	.10	.09
South Carolina	42	28	1.64	1.51	.70	.49	.11	.06	4.51	.14	.14
Arkansas	58	17	3.76	1.89	.70	2.01	.04	.11	8.51	.15	.21
Utah	68	18	4.11	2.21	1.00	2.72	2.00	.19	12.23	.13	.09
Washington:											
Central irrigated	66	18	4.06	2.15	1.00	4.97	2.62	.20	15.00	.15	.10
North coast	49	25	2.08	1.54	1.50	.37	.26	.07	5.82	.17	.06
California	60	21	2.79	2.25	1.00	4.87	3.60	.35	14.86	.09	.08
Average[2]	48	23	2.51	1.65	1.22	2.11	1.04	.17	8.70	.13	.11

[1] See footnote 1, table 2.

[2] Average based on 553 dump rakes.

TABLE 50.—*Estimated annual machine cost of hayloaders, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per acre	Per ton
						Cash	Farm labor	Lubricating oil, grease etc.			
		Years									
New York:											
Eastern	$118	23	$5.13	$3.54	$3.50	$3.00	$0.91	$0.30	$16.38	$0.27	$0.18
Central	147	19	7.68	4.38	3.50	1.89	.55	.33	18.33	.35	.19
Western	146	20	7.30	4.38	3.50	2.06	1.10	.29	18.63	.37	.26
Pennsylvania:											
South central	127	21	6.05	3.80	3.50	.83	.80	.18	15.16	.40	.28
Northwestern	150	23	6.52	4.50	3.50	.44	.31	.25	15.52	.39	.20
Wisconsin	128	26	4.92	3.84	3.35	.58	.30	.21	13.20	.39	.20
Minnesota	124	22	5.64	4.22	3.35	.58	.30	.16	14.25	.32	.30
Nebraska	136	20	6.80	4.08	3.30	1.42	.52	.24	16.36	.25	.23
Virginia	171	16	10.68	5.12	3.15	4.86	2.40	.50	26.71	.18	.17
Tennessee	200	20	10.00	6.00	2.35	1.50	.50	.25	20.60	.28	.28
Arkansas	200	20	10.00	6.00	2.35	1.50	.50	.22	20.57	.31	.31
Washington: North coast	188	18	10.44	5.34	3.50	2.57	2.12	.40	24.37	.58	.20
California	229	12	19.08	6.86	2.65	10.00	9.35	.75	48.69	.31	.28
Average[2]	158	20	8.48	4.77	3.19	1.76	1.02	.28	19.50	.36	.21

[1] See footnote 1, table 2.

[2] Average based on 463 hay loaders.

TABLE 51.—*Estimated annual machine cost of horse and tractor buckrakes, sample farms, 1945*

State and area[1]	Cost when purchased	Estimated life	Machine cost							
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per ton
						Cash	Man labor	Miscellaneous		
		Years								
New York:										
Eastern	$100	10	$10.00	$3.00	$3.00	$4.00	$0.50	$0.30	$20.80	$0.30
Central	102	10	10.20	3.06	3.00	1.20	.30	.30	18.06	.26
Western	121	11	11.00	3.62	3.00	4.05	1.90	.40	23.97	.30
Pennsylvania:										
South Central	125	15	8.33	3.66	3.00	2.00	.45	.35	17.79	.51
Northwestern	116	15	7.73	3.48	3.00	4.00	.60	.40	19.21	.30
Wisconsin	78	12	6.50	2.34	3.00	1.65	.50	.50	14.49	.17
Minnesota	55	15	3.67	1.66	2.75	1.00	.30	.40	9.78	.14
Nebraska	135	15	9.00	4.06	2.70	4.00	1.00	.40	21.16	.42
North Dakota	66	16	4.12	1.98	2.25	7.80	1.00	2.00	19.15	.04
Utah	124	16	7.75	3.72	2.25	12.00	6.90	.75	33.37	.14
Washington:										
Central irrigated	98	15	6.53	2.94	2.25	7.00	4.50	.75	23.97	.11
North coast	103	12	8.58	3.10	3.00	1.80	2.00	.50	18.98	.17
Average[2]	99	15	6.74	2.98	2.80	6.80	3.70	.94	23.96	.10
Average[3]	113	13	10.28	3.38	2.95	3.03	.93	.39	20.96	.31
Average[4]	92	16	5.00	2.76	2.40	8.53	4.95	1.18	24.82	.08

[1] See footnote 1, table 2.

[2] Based on all 229 horse or tractor buckrakes reported.

[3] Based on 72 buckrakes, excluding those in Minnesota, North Dakota, Utah, and the central irrigated area of Washington, where much of the hay is stacked.

[4] Based on 157 buckrakes reported in Minnesota, North Dakota, Utah, and the central irrigated area of Washington.

TABLE 52.—*Estimated annual machine cost of auto buckrakes including fuel for motor, sample farms, 1945*

State and area[1]	Cost when purchased	Estimated life	Machine cost								
			Depreciation	Interest and taxes	Housing	Repairs and services			Fuel	Total	Per ton
						Cash	Man labor	Miscellaneous			
		Years									
New York:											
Eastern	$ 149	9	$16.55	$4.47	$8.00	$5.40	$2.30	$0.60	$14.45	$51.77	$0.74
Central	202	10	20.20	6.06	8.00	10.20	2.05	1.00	10.70	58.21	.58
Western	219	8	27.38	6.58	8.00	17.50	2.05	1.15	14.20	76.86	.67
Pennsylvania:											
South central	190	12	15.83	5.70	8.00	6.50	1.10	1.00	12.00	50.13	.53
Northwestern	183	14	13.07	5.50	8.00	7.00	1.20	1.05	13.50	49.32	.47
Wisconsin	207	13	15.92	6.22	8.00	7.50	1.00	.70	9.20	48.54	.69
Minnesota	210	15	14.01	6.30	7.50	7.00	1.20	.85	9.50	46.36	.55
North Dakota	535	15	35.68	16.06	6.00	7.00	2.00	3.25	50.00	119.99	.16
Washington:											
Central irrigated	308	12	25.67	9.24	6.00	8.00	6.00	2.00	26.00	82.91	.33
North coast	228	15	15.20	6.84	8.00	1.00	.65	.55	11.00	43.24	.41
Average[2]	211	10	21.76	6.33	7.74	12.29	2.53	1.14	16.55	68.34	.65
Average[3]	204	10	21.58	6.14	8.00	12.03	1.80	1.03	12.80	63.38	.61
Average[4]	255	11	22.87	7.66	6.14	13.90	7.07	1.82	37.38	96.84	.26

[1] See footnote 1, table 2.

[2] Based on all 151 buckrakes reported.

[3] Based on 130 buckrakes, excluding those in Minnesota, North Dakota, Utah, and the central irrigated area of Washington where much of the hay is stacked.

[4] Based on 21 buckrakes reported in Minnesota, North Dakota, Utah, and the central irrigated area of Washington.

TABLE 53.—*Estimated annual machine cost of specified hay stacking equipment, sample farms, 1945*

State and area[1]	Cost when purchased	Estimated life	Machine cost						
			Depreciation	Interest and taxes	Repairs and services			Total	Per ton
					Cash	Farm labor	Miscellaneous		
OVERSHOT STACKERS									
North Dakota	$ 96	*Years* 22	$4.36	$2.88	$8.05	$1.00	$0.60	$16.89	$0.03
DERRICK STACKERS									
Utah	140	22	6.67	4.20	7.00	3.15	.15	21.17	.14
SLINGS AND CABLE[2]									
Utah	32	.....	3.00	.96	2.00	.55	.15	6.66	.04

[1] See footnote 1, table 2. [2] Per derrick reported.

TABLE 54.—*Estimated annual machine cost of buckstackers, sample farms, 1945*

State and area[1]	Cost when purchased	Estimated life	Machine cost							
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per ton
						Cash	Farm labor	Miscellaneous		
		Years								
Wisconsin	$400	17	$23.53	$12.00	$3.00	$2.00	$0.50	$0.45	$41.48	$0.44
Minnesota	412	15	27.46	12.36	2.75	6.25	.65	.45	49.92	.55
North Dakota	395	15	26.33	11.86	2.25	8.00	1.00	.60	50.04	.09
Nebraska	245	13	18.81	7.34	2.70	1.20	.65	.35	31.05	.41
Utah	333	20	16.65	9.90	2.25	4.00	2.50	1.75	37.05	.09
Washington:										
Central irrigated	395	15	26.33	11.86	2.25	5.00	1.00	1.50	47.94	.16
North coast	375	15	25.00	11.26	3.00	10.50	2.00	1.00	52.76	.25
Average[2]	365	16	23.29	10.94	2.60	4.98	1.18	.87	43.86	.22

[1] See footnote 1, table 2. [2] Based on 28 machines.

TABLE 55.—*Estimated annual machine cost of stationary and shock balers, including wire cost, sample farms, 1945*

POWERED BY TRACTORS OR AUXILIARY MOTORS

State and area[1]	Cost when purchased new	Estimated life	Machine cost									Hay baled	Machine cost per ton
			Depreciation	Interest and taxes	Housing	Repairs and services			Fuel and oil for auxiliary motors[2]	Wire	Total		
						Cash	Farm labor	Lubricating oil and grease					
New York:		*Years*										*Tons*	
Central	$825	20	$41.25	$29.75	$6.00	.....	$1.00	$0.25	$3.75	$11.50	$93.50	21	$4.45
Western	225	25	9.00	6.75	6.00	$8.30	10.00	.50	5.75	18.00	64.30	49	1.31
Pennsylvania:													
South central	440	22	20.00	13.20	6.00	.....	4.00	2.50	24.00	138.75	208.45	250	.83
Virginia	700	17	41.20	21.00	5.00	12.50	2.00	.75	.....	40.00	122.45	80	1.53
Tennessee	500	23	21.70	15.00	4.50	2.65	1.80	4.00	.....	220.00	269.65	445	.61
South Carolina	626	20	31.30	18.80	3.50	5.00	2.00	2.00	.....	63.00	125.60	125	1.00
Arkansas	765	15	51.00	22.95	3.50	.....	.....	1.00	.....	50.00	128.45	105	1.22
California	495	15	33.00	15.10	5.00	25.00	12.00	2.00	20.00	100.00	212.10	195	1.09
Average[3]	613	20	34.43	18.38	4.50	5.09	2.80	1.66	2.57	73.00	142.43	144	.99

POWERED BY WORK ANIMALS

Tennessee	250	25	10.00	7.50	4.50	5.00	1.80	.50	.....	25.00	54.30	50	1.09
South Carolina	135	25	5.40	4.05	3.50	2.50	1.00	.25	.....	10.00	26.70	20	1.33
Arkansas	300	25	12.00	9.00	3.50	.....	.....	.15	.....	10.00	34.65	20	1.73
Average[4]	215	25	8.60	6.46	3.75	2.50	.94	.29	.....	14.28	36.82	28	1.31

[1] See footnote 1, table 2.
[2] Average includes all mechanically powered stationary and shock balers reported.
[3] Based on 33 balers.
[4] Based on 7 balers.

TABLE 56.—*Estimated annual machine cost of automatic-tie pickup balers, including twine cost, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost									Hay baled	Machine cost per ton
			Depreciation	Interest and taxes	Housing	Repairs and services			Fuel and oil for auxiliary motors[2]	Twine	Total		
						Cash	Farm labor	Lubricating oil and grease					
		Years										*Tons*	
New York:													
Eastern	$1,911	12	$159.20	$57.30	$6.00	$67.75	$ 16.35	$4.55	$36.00	$248	$595.15	456	$1.31
Central	1,901	12	158.40	57.00	6.00	65.00	24.65	4.40	35.00	239	589.45	440	1.34
Western	1,784	9	198.20	53.50	6.00	64.85	18.50	9.70	77.00	527	954.75	969	.99
Pennsylvania:													
South central	1,836	11	167.00	55.10	6.00	72.70	24.00	6.50	51.65	348	730.95	640	1.14
Northwestern	1,860	10	186.00	55.80	6.00	70.19	26.00	8.10	65.15	438	855.24	806	1.06
Wisconsin	1,800	10	180.00	53.00	6.00	43.00	9.00	4.75	37.00	271	603.75	495	1.22
Virginia	1,910	10	191.00	57.30	5.00	29.00	34.00	4.00	30.00	223	573.30	410	1.40
Tennessee	1,740	10	174.00	52.20	4.50	87.50	27.00	12.00	130.00	760	1247.20	1,400	.89
Utah[3]	1,960	12	163.30	58.80	5.00	26.00	40.00	2.00	14.00	108	417.10	200	2.09
Washington:													
North coast	1,975	10	197.50	59.25	6.00	125.00	18.00	6.50	37.00	348	797.25	640	1.25
California	2,250	8	281.00	67.50	5.00	175.00	84.00	11.00	88.50	609	1321.00	1,120	1.18
Average[4]	1,868	10	183.20	56.00	5.50	72.87	24.51	7.27	58.03	402	809.38	738	1.10

[1] See footnote 1, table 2.
[2] Average includes all automatic-tie balers reported.
[3] Average quantity baled was low because two of the balers were bought after the haying season had begun.
[4] Based on 91 balers.

TABLE 57.—*Estimated machine cost of three-man pickup balers, including wire cost, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost									Hay baled	Machine cost per ton
			Depreciation	Interest and taxes	Housing	Repairs and services			Fuel and oil for auxiliary motors[2]	Wire	Total		
						Cash	Farm labor	Lubricating oil and grease					
New York:		*Years*										*Tons*	
Eastern	$1,090	12	$90.80	$32.70	$6.00	$16.75	$13.60	$3.50	$16.40	$188	$367.75	380	$0.97
Central	957	12	79.75	28.75	6.00	31.65	14.00	3.50	29.00	224	416.65	407	1.02
Western	1,176	12	98.00	35.30	6.00	32.80	8.80	3.00	22.00	182	387.90	330	1.18
Pennsylvania:													
South central	955	12	79.60	30.70	6.00	33.20	5.80	3.10	25.40	176	359.80	320	1.12
Northwestern	1,030	11	93.65	30.70	6.00	30.75	10.70	4.75	41.40	275	492.95	500	.99
Wisconsin	1,064	12	88.60	31.90	6.00	15.00	3.50	5.75	25.00	327	502.75	595	.84
Minnesota	850	13	65.40	25.50	5.50	17.50	2.25	2.75	24.80	143	286.70	260	1.10
Nebraska	1,100	10	110.00	33.00	5.50	38.50	7.80	6.00	74.60	330	605.40	600	1.01
Virginia	1,050	11	95.40	31.50	5.00	60.00	8.00	2.00	12.00	124	337.90	225	1.50
Tennessee	1,040	15	69.30	31.20	4.50	44.10	2.50	6.50	50.00	355	563.10	650	.87
Arkansas	1,150	12	96.00	34.50	3.50	87.50	1.50	2.50	31.00	154	410.50	280	1.47
Utah	1,090	12	91.00	33.20	5.00	86.00	28.00	3.00	22.00	165	433.20	325	1.33
Washington:													
Central irrigated	1,160	12	96.65	34.80	5.00	90.00	24.80	6.00	25.00	316	598.25	630	.95
North coast	1,135	10	113.50	34.05	6.00	28.50	22.50	4.00	20.00	205	433.55	410	1.06
California	1,220	8	152.50	36.60	5.00	122.00	20.00	11.00	95.00	625	1067.10	1,140	.94
Average[3]	1,081	12	93.00	32.40	5.50	49.76	11.45	4.38	34.65	238	469.14	432	1.09

[1] See footnote 1, table 2. [2] Average includes all three-man balers reported. [3] Based on 180 balers.

TABLE 58.—*Estimated annual machine cost of four-man and five-man pickup balers, including wire cost, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost									Hay baled	Machine cost per ton
			Depreciation	Interest and taxes	Housing	Repairs and services			Fuel and oil for auxiliary motors[2]	Wire	Total		
						Cash	Farm labor	Lubricating oil and grease					
New York:		*Years*										*Tons*	
Eastern	$ 900	12	$75.00	$27.00	$6.00	$0.75	$6.50	$2.45	$23.75	$135	$276.45	245	$1.13
Western	1,043	13	80.25	31.30	6.00	18.50	6.75	2.10	21.00	123	288.90	210	1.38
Pennsylvania:													
South central	845	12	70.40	42.25	6.00	22.00	4.25	4.00	37.50	234	420.40	425	.99
Northwestern	750	15	50.00	22.50	6.00	.75	1.65	1.50	14.40	82	178.80	150	1.19
Nebraska	868	10	86.80	26.00	5.50	25.00	2.00	9.00	85.00	450	689.30	900	.77
Arkansas	850	12	71.00	25.50	3.50	25.00	1.50	1.50	16.00	96	240.00	175	1.37
Utah	1,035	12	86.25	31.05	5.00	48.00	20.00	3.50	28.00	195	416.80	380	1.10
Washington:													
Central irrigated	1,500	12	125.00	45.00	5.00	90.00	15.00	6.50	35.00	325	646.50	650	.99
California	1,800	6	300.00	54.00	5.00	187.00	32.00	14.50	115.00	75	782.50	1,450	.54
Average[3]	1,156	12	117.02	34.68	5.50	53.02	11.25	4.69	39.55	260	525.71	473	1.11
Average[4]	993	13	78.23	29.78	5.50	22.03	6.61	2.49	24.21	140	308.85	255	1.21

[1] See footnote 1, table 2.
[2] Average includes all four-man and five-man balers reported.
[3] Based on all 62 balers reported.
[4] Exclusive of the high-capacity balers in the central irrigated area of Washington and in California.

TABLE 59.—*Estimated annual machine cost of bale loaders, sample farms, 1945*

State and area[1]	Cost when purchased new	Estimated life	Machine cost							
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Per ton
						Cash	Farm labor	Lubricating oil, grease, etc.		
		Years								
New York:										
Central	$300	15	$20.00	$8.80	$3.00	.....	.....	$0.35	$32.15	$0.10
Western	207	15	13.80	6.20	3.00	$1.20	.....	.15	24.35	.16
California	346	11	31.45	10.40	2.25	16.00	$14.00	1.25	75.35	.06
Average[2]	319	12	27.46	9.58	2.45	11.98	10.32	.98	62.77	.06

[1] See footnote 1, table 2. [2] Based on 19 bale loaders of which 14 were in California.

TABLE 60.—*Estimated annual machine cost of bale elevators including electricity and gasoline for motors, sample farms, 1945*

POWERED WITH ELECTRIC MOTORS

State and area[1]	Cost when purchased new	Estimated life	Machine cost								Time used	Hay handled	Machine cost per ton
			Depreciation	Interest and taxes	Housing	Repairs and services: Cash	Repairs and services: Farm labor	Repairs and services: Lubricating oil, grease, etc.	Electricity and gasoline	Total			
New York:		*Years*									*Hours*	*Tons*	
Eastern	$133	15	$8.90	$4.00	$1.50	$0.10	.....	$0.05	$0.60	$15.15	40	230	$ 0.07
Central	110	15	7.35	3.30	1.50	.....	.....	.05	1.40	13.60	36	185	.07
Western	122	15	8.15	3.65	1.50	.15	$0.30	.05	.75	14.55	31	185	.08
Pennsylvania:													
South central	102	16	6.40	3.05	1.50	.....	.....	.10	1.40	12.45	62	300	.04
Northwestern	96	17	5.15	2.90	1.50	.15	.15	.10	1.10	11.05	48	265	.04
Average[2]	117	15	7.68	3.49	1.50	.05	.15	.06	.95	13.88	39	216	.06

POWERED WITH GASOLINE ENGINES

Washington:													
Central irrigated[3]	248	19	13.05	7.45	1.10	.....	.....	1.50	9.20	32.30	([4])	250	.13

[1] See footnote 1, table 2.
[2] Average based on 52 bale elevators powered by electric motors.
[3] Average based on 5 bale elevators powered by gasoline engines and used for stacking bales in ricks in the hay fields.
[4] Not obtained.

TABLE 61.—*Estimated annual machine cost of stationary choppers, sample farms, 1945*[1]

State and area[2]	Cost when purchased	Estimated life	Machine cost							Time used		Machine cost per hour
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Total	On hay crops[3]	
						Cash	Farm labor	Lubricating oil, grease, etc.				
		Years								*Hours*	*Hours*	
New York:												
Eastern	$299	16	$18.70	$8.95	$4.00	$2.50	$2.00	$0.35	$36.50	70	32	$0.52
Central	320	16	20.00	9.60	4.00	4.00	2.00	.45	40.05	68	48	.59
Western	385	16	24.05	11.55	4.00	3.65	1.65	.40	45.30	83	32	.55
Pennsylvania:												
South central	365	20	18.25	10.95	4.00	2.35	3.35	.25	39.15	51	19	.77
Northwestern	413	19	21.75	12.40	4.00	8.30	3.85	.30	50.60	65	22	.78
Wisconsin	344	20	17.20	10.30	4.00	10.00	.80	.30	42.60	60	30	.71
Minnesota	440	25	17.60	13.20	3.75	19.00	2.25	.30	56.10	65	28	.86
Washington:												
Central irrigated	400	13	30.75	12.00	3.50	16.65	9.35	.75	73.00	150	150	.49
North coast	357	16	22.30	10.70	4.00	10.60	6.00	.40	54.00	80	78	.68
California	550	11	50.00	16.50	3.50	35.00	14.00	2.10	121.10	210	150	.58
Average[4]	390	17	24.41	11.70	3.94	9.75	4.46	.51	54.77	88	55	.62

[1] Includes ensilage cutters used to elevate hay chopped with field pickup choppers.

[2] See footnote 1, table 2.

[3] Includes use on grass silage.

[4] Average based on 88 machines.

TABLE 62.—*Estimated annual machine cost of power-take-off type field pickup choppers, sample farms, 1945*[1]

State and area[2]	Cost when purchased	Estimated life	Machine cost							Time used		Machine cost per hour
			Depreciation	Interest and taxes	Housing	Repairs and services			Total	Total	On hay crops[3]	
						Cash	Farm labor	Lubricating oil, grease, etc.				
		Years								*Hours*	*Hours*	
New York:												
Western	$765	10	$76.50	$22.95	$6.00	$5.00	$3.00	$1.00	$114.45	100	45	$1.14
Pennsylvania:												
South central	875	15	58.30	26.40	6.00	4.00	3.50	.55	98.75	53	22	1.86
Northwestern	990	15	66.00	29.70	6.00	13.50	3.25	1.20	119.65	120	30	1.00
Wisconsin	845	10	84.50	25.35	6.00	18.30	1.65	2.20	138.00	220	75	.63
Minnesota	800	12	66.65	24.00	5.50	5.00	1.10	1.25	103.50	125	50	.83
Utah	660	10	66.00	19.80	5.00	5.00	2.00	1.50	99.30	160	160	.62
Washington:												
Central irrigated	875	13	67.30	26.20	5.00	31.00	13.30	.65	143.45	65	65	2.21
California	685	6	114.15	20.50	5.00	80.00	34.00	2.25	255.90	225	212	1.14
Average[4]	[5]814	11	74.94	24.42	5.54	19.91	7.38	1.35	133.54	135	75	.99

[1] Includes row-crop attachment on choppers used on row crops in addition to hay crops.

[2] See footnote 1, table 2.

[3] Includes use on grass silage.

[4] Based on 24 machines for which costs were obtained.

[5] Average cost when bought without row-crop attachment was approximately $750 per machine.

TABLE 63.—*Estimated annual machine cost of mounted-motor type field pickup choppers, sample farms, 1945*[1]

State and area[2]	Cost when purchased	Estimated life	Machine cost								Time used		Machine cost per hour
			Depreciation	Interest and taxes	Housing	Repairs and services				Total	Total	On hay crops	
						Cash	Farm labor	Lubricating oil, grease, etc.	Fuel for auxiliary motor				
		Years									*Hours*	*Hours*	
New York:													
Western	$1,875	12	$156.25	$56.25	$6.00	$3.75	$ 0.50	$0.70	$15.00	$238.45	68	50	$3.51
Pennsylvania:													
South central	1,692	16	105.75	50.75	6.00	3.00	9.60	.55	10.50	186.15	53	18	3.51
Northwestern	1,938	13	149.10	58.15	6.00	40.35	8.65	.75	17.50	280.50	73	24	3.84
Wisconsin	1,510	12	125.80	45.30	6.00	5.00	2.00	.95	22.80	207.85	95	40	2.19
Minnesota	1,754	12	146.15	52.55	5.50	2.50	.10	1.00	24.00	231.80	100	40	2.32
Utah	1,570	11	130.85	47.10	5.00	2.00	6.65	.95	23.00	215.55	95	75	2.27
Washington:													
Central irrigated	1,400	15	93.35	42.00	5.00	40.00	5.00	.75	18.00	204.10	75	75	2.72
North coast[4]	1,700	15	133.30	51.00	6.00	2.00	2.50	1.00	25.00	220.80	100	100	2.21
California	1,818	6	303.00	54.55	5.00	122.00	44.50	3.50	84.00	616.55	350	335	1.76
Average[5]	[6]1,732	10	202.41	51.96	5.47	54.16	20.25	1.93	46.12	382.30	182	160	2.10

[1] Includes the row-crop attachment on choppers used on row crops in addition to hay crops.
[2] See footnote 1, table 2.
[3] Includes use on grass silage.
[4] All use on hay crops was on grass silage.
[5] Average based on 45 machines for which costs were obtained.
[6] Average cost when bought without row-crop attachment was approximately $1,600 per machine.

TABLE 64.—*Estimated annual machine cost of blowers, sample farms, 1945*[1]

USED FOR CHOPPED HAY

State and area[2]	Cost when purchased	Estimated life	Machine cost							Time used		Machine cost per hour
			Depreciation	Interest and taxes	Housing	Repairs and services: Cash	Repairs and services: Farm labor	Repairs and services: Lubricating oil, grease, etc.	Total	Total	On hay crops[3]	
Pennsylvania:		*Years*								*Hours*	*Hours*	
South central	$246	20	$12.30	$7.40	$4.00	.....	$1.40	$0.15	$25.25	35	15	$0.72
Northwestern	287	15	19.15	7.30	4.00	.....	1.40	.60	32.45	130	30	.25
Wisconsin	230	10	23.00	6.90	4.00	.....	.50	.55	34.95	120	45	.29
Minnesota	325	12	27.10	9.75	3.75	.....	.50	.50	41.60	110	45	.38
Utah	245	11	22.20	7.35	3.50	$2.50	4.25	.30	40.10	70	55	.57
California	286	6	47.60	8.60	3.50	13.00	7.65	.85	81.20	190	185	.43
Average[4]	283	10	24.96	8.50	3.66	5.60	4.06	.55	47.33	135	100	.35

USED FOR LONG HAY

New York: Western[5]	106	11	9.65	3.20	4.00	1.55	.15	.25	18.80	55	15	.34

[1] Does not include ensilage cutters used as blowers.
[2] See footnote 1, table 2.
[3] Includes use on grass silage.
[4] Average based on 25 blowers.
[5] Average based on 9 blowers.

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